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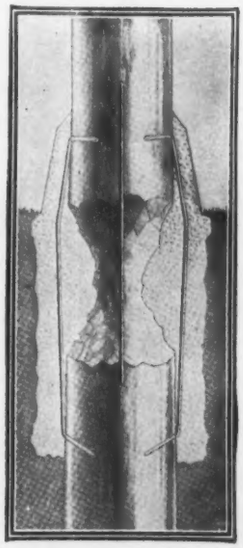

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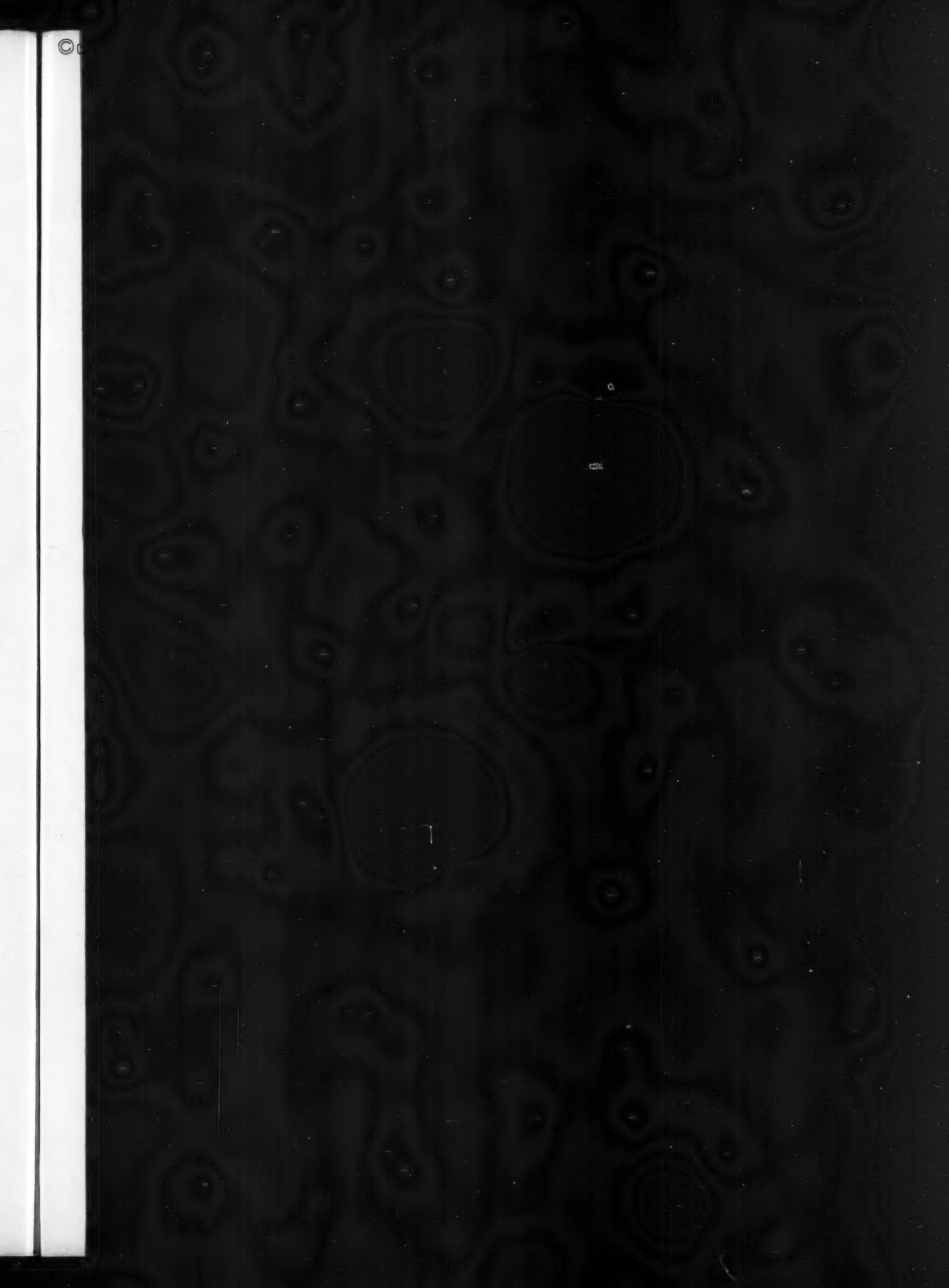

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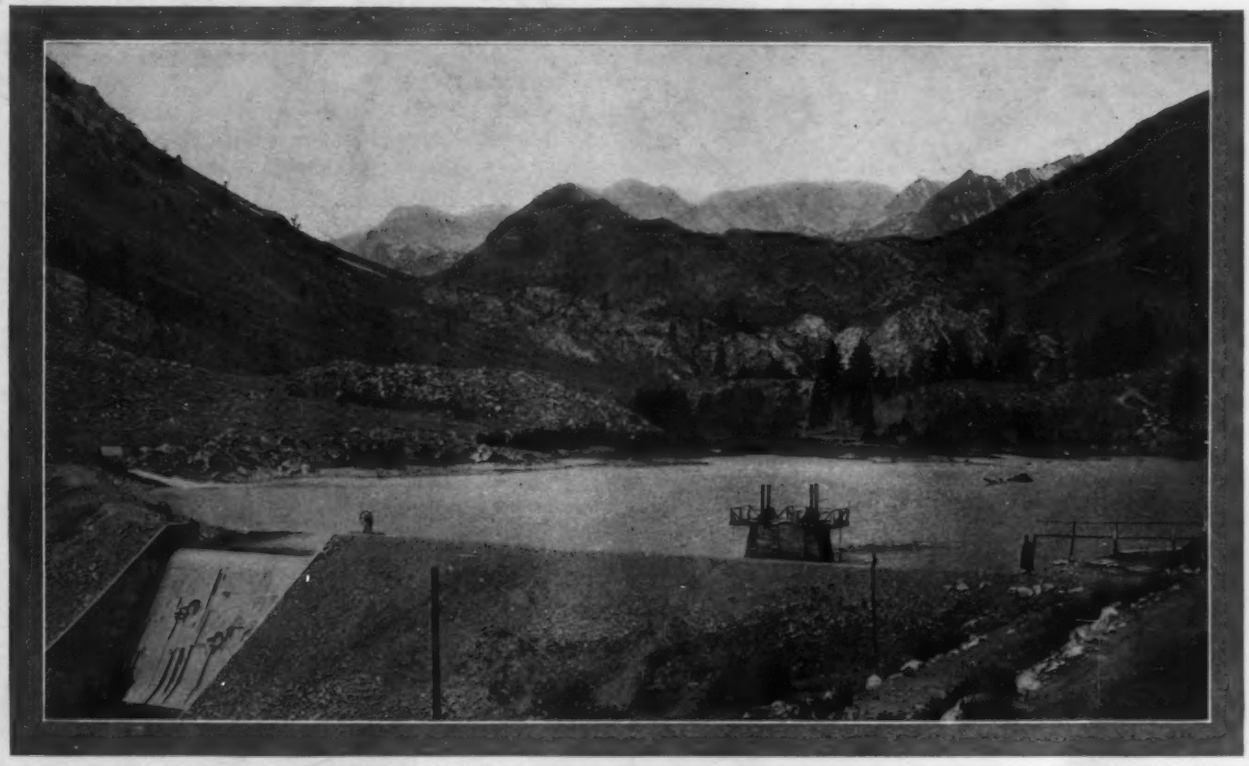
SYSTEM OF SOUTHERN SIERRAS POWER COMPANY

PART I — POWER PLANTS

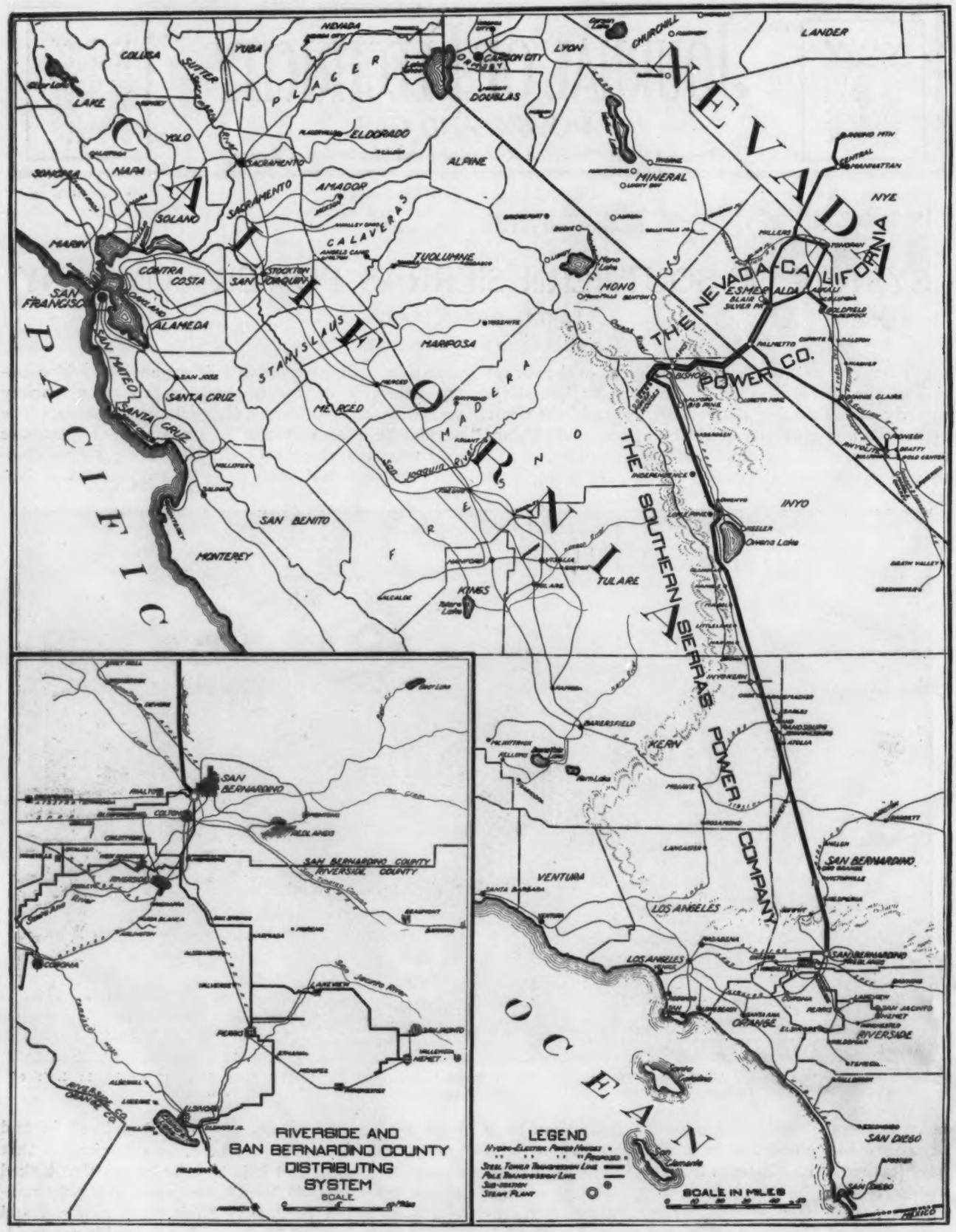
BY RUDOLPH W. VAN NORDEN.[1]

There is a vast territory extending from the abrupt rise of the Sierra Nevada as its western boundary, easterly and including the southern part of the State of Nevada and southerly to the San Bernardino Mountains, possessing untold potential wealth. This area of twenty-five thousand square miles, part plain, part mountain range, is looked upon by those who have perchance but crossed it in a Pullman car, or who have learned of its existence from their geographies, as a desert. On the maps one will find the names Mojave Desert, Indian Wells Valley, Panamint Mountains, Funeral Range, Amargosa Desert, Death Valley. To the uninitiated, the city dweller, there can seem but little promise in this expanse of arid country unless it be for minerals in countless variety known to exist hidden in its geological cosmos. The development of a system to transmit and distribute over this area, electrical energy for every sort of commercial use would seem to be an exploitation of fanciful fields. But to the one who has lived in and studied this desert its lure becomes a fascination that cannot be shaken and it is he who knows that locked within its reaches is boundless wealth, not only mineral wealth, but productive lands, deep rich soil and millions of acres of it almost for the taking, providing that there can be supplied that which nature failed to supply—water. All this has, of course, been known



Intake and Forebay Reservoir of No. 2 Powerplant. No. 1 Powerhouse Will Be Placed Near Pile of Rocks in Left of Picture. Lake Sabrina Lies to Left of the Butte in the Center Background.

[1]Fellow, A. I. E. E.; Member, A. S. C. E.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and understood since man has known the desert, and the insurmountable problem was met and conquered only with the advent of power, within the means of the individual, for obtaining water by pumping.

The seasons in this country produce a winter which lasts, in the higher altitudes, from November to May, and snow in quantity increases with the altitude, while in the more level stretches rains more or less torrential occur. The mountains, oftentimes rising to elevations of twelve thousand feet, except for the greasewood and sagebrush covering which is com-

Hauling Cement in Winter.

mon to these desert areas, are bare. The canyons, ravines and gulches which make up the countless serrations in the mountain sides are steep and ragged and the runoff from the melting snows becomes angry torrents at the beginning of the summer season. Likewise the downpours of sudden rains cause the ordinarily dry arroyas, which head into the mountain canyons, to become for short periods dangerous watercourses whose floods carry boulders and trees and brush before it and may be the means of destroying railroads or other works of man which are in its path. It is thus from this lack of conservation that the sudden floods, soon dissipated in the more level stretches by sinking in many cases to form underground strata of moisture, leave the surface of the country a dry waste throughout the six months or more of summer under almost cloudless skies.

To pump water for irrigation or to obtain power for operating mines or other industries becomes a serious problem, there being practically no local fuel, and the importation of fuel, due to few railroads, high freights and high hauling charges, makes the cost of power almost prohibitive. The generation of electricity from the power of falling water in most instances becomes impracticable because of the impossibility of conserving the flow to allow of an even distribution throughout the year.

In the northern extremity of the area under discussion, there is a fairly flat and wonderfully fertile valley, over 100 miles long and six or seven miles wide. This area, known as the Owens valley, lies in a north and south strip, itself at an elevation of 4,000 ft., between the line of summit peaks of the Sierra Nevada and the White Mountain range, almost as high. The Sierra Nevadas, many of whose peaks are above the 14,000 ft. elevation, deliver into the Owens valley through deep and steep canyons, one after another, the runoff from its eastern slope. Some of these streams possess a very considerable watershed area and the runoff is large from the time of the melting of the snows to the Fall months and in fact until the oncoming winter when the resulting cold in these higher areas causes a diminution in the flow.

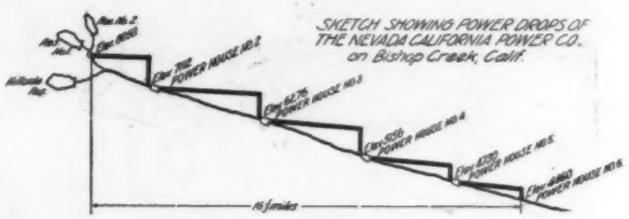
The opportunity for the development of hydroelectric power in many of these streams would be ideal if nature had provided means of storage. But in most cases storage among these beetling cliffs and peaks would become so costly as to be prohibitive.

The Owens river having its source in the mountains at the northern extremity of the valley is fed from the streams of the Sierras and gathers in volume, much of its flow passing underground, however, until it is poured into the Owens Lake at the southern end of the valley. This lake has no outlet and is therefore strongly alkaline and in itself supplies the raw material for chemical recovery works of various kinds.

Of the streams feeding the Owens river, one of the largest is Bishop creek. This creek has its rise in three branches or watersheds, known as the north, middle and south forks, and it is the very high efficiency power development of its watershed that forms the basis of the power system about to be described.

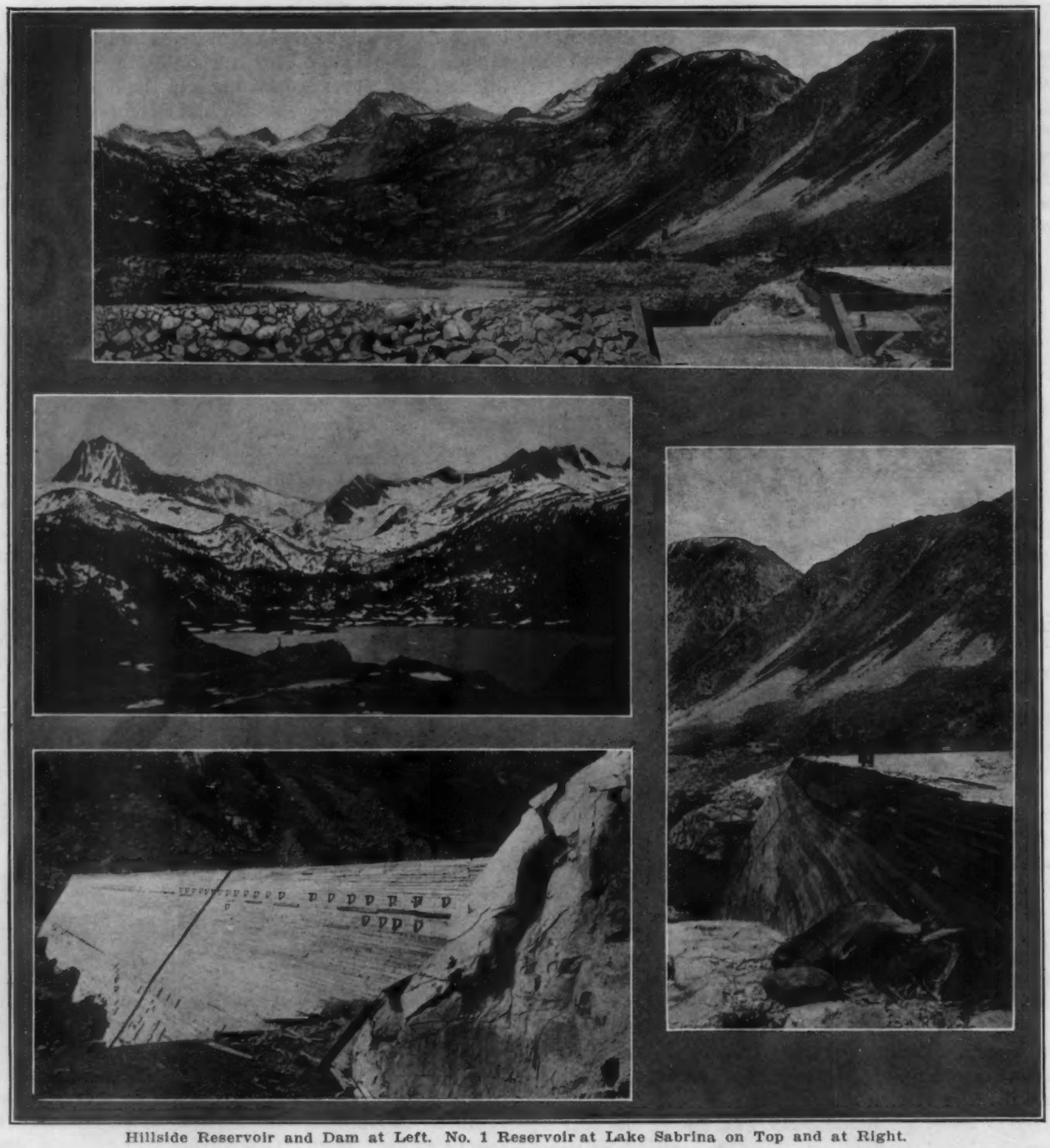
The Original Development.

The sensational discovery and development of rich gold mines at Tonopah and Goldfield in the State of Nevada in 1904 created a concentrated market for the sale of electrical energy and it was with this outlet in view that a company was formed to develop the



Profile of Relative Position of Plants.

nearest dependable water power, something over 100 miles distant, which resulted in the first plant to be installed on Bishop creek. In 1905 the powerhouse then installed, now known and consisting of a part of power plant No. 4, was looked upon as a very daring venture. A transmission line was built, crossing the Owens valley, thence over the White mountain range through a pass at an altitude of 10,000 ft., thence crossing several valleys and mountain ranges, all desert country and finally branching to reach the two cities above named. This plant consisting of two 750 kw. machines was soon loaded and the powerhouse was increased 300 per cent in generating capacity. Another transmission line was built into Nevada and was extended over one hundred miles southward to Rhyolite in the Bullfrog district, incidentally reaching many other mining camps. The possibilities of developing a power business throughout the desert regions and the advances made in the science of electric transmission pointed to the ultimate development of the entire fall in Bishop creek, to form in a series of power plants a system of unusual economy and efficiency.



Hillside Reservoir and Dam at Left. No. 1 Reservoir at Lake Sabrina on Top and at Right.

Sierra Nevada streams are unique in possessing short rivers having rapid falls, thus making possible the development of large powers with a comparatively small quantity of water. The streams on the eastern slope of the Sierra Nevadas are much more characteristic in this feature than those of the western slopes. Bishop creek has a mean length before it emerges from its canyon of about 14 miles and in this distance the fall is 5,500 ft., or nearly 400 ft. to the mile. The depth of the canyon walls is in most places about 1,000 feet. It became a matter of engineering study to determine the number of power plants which could in the most economical manner, be placed in tandem to utilize the mean-maximum flow possibility of the watershed. This number was fixed at seven, and the plants known as "A" and the numbers one to six.

As the business in Nevada developed the plant development kept pace. After the first plant, which was No. 4, came No. 5, built in 1907, a much smaller but low cost plant. Then No. 2 followed in 1908, a most ideal example of pure Western practice of its time. The company so far, known as the Nevada-California Power Company, had kept pace with its market for its power, but by reaching further the full development of the watershed was foreseen as a good business possibility.

In 1911, the transmission of power at voltages of over 100,000 having proven perfectly feasible, it was

decided after a careful study of the problem to carry a transmission line southward, passing throughout the length of the fertile Owens valley, thence paralleling the recently completed aqueduct which will carry water from the Owens river to the city of Los Angeles, passing through Rose Springs valley, Indian Wells valley, thence through the Randsburg mining district, across the Mojave desert, and finally crossing the San Bernardino range to the city and valley of the same name, a distance of 239 miles. The desert country with a few exceptions where immediate sale for power was possible, was at least a promising field for power development, but the San Bernardino valley with its cities of San Bernardino, Riverside, Redlands, Corona and many smaller towns and a vast area of country, was a prolific field to form a sure power market. In order to carry forward this immense project and complete the power plant developments, a new company was formed and this, the Southern Sierras Power Company is the subject of interest in this description, although it will be advisable to describe the plants of the older company in order to give a comprehensive idea of the chain of power plants which extract from the fall of water each in their turn, all of the power made available by nature.

When it was determined to reach the prosperous and highly cultivated district South of the San Bernardino range to find a market for the newer power plants on Bishop creek, the transmission of this power so great a distance was recognized as being not only a problem of engineering of the most advanced type to merely accomplish the object, but also one in commercial engineering of no mean magnitude. For this district, which includes cities and many towns, was one of the first to enjoy the advantages of electricity and the service requirement on which to build a successful business is rigid. The powerhouse system is complete and carefully designed to meet the very wide service conditions in an enormously scattered territory. The transmission system represents the last word not only in modern design, but in particular detail, and the last precaution has been taken in the installation of the steam plant at San Bernardino, which has sufficient capacity to carry the greater part of the load in an emergency and perform valuable service in regulation at all times.

Characteristics.

At the present time this system becomes interesting to engineers and the general field of modern engineering due to four well defined characteristics.

The efficiency of transmission, and the load factor, are uncommonly high and the cost of operation is unusually low. The former at 80 per cent load factor shows a loss of 18 per cent, while the latter is but 18 per cent of the gross, an unusual coincidence.

The efficiency of the watershed is, or will be, 100 per cent effective. The water after leaving the storage reservoirs, does not follow in the natural waterway until utilized by the last plant from whence it is discharged into an irrigation system.

The transmission line, which is the spectacular feature of the system, is one of the longest, if not the longest, straight-away line, built for the highest commercial voltage yet to be used, using steel-aluminum conductors and being throughout of unique design, forming a new step in the advance of power transmission practice.

Throughout, standards of design have been adopted which show a careful thought and a thorough understanding of the many intricate problems incident to the development of such a system. A fearlessness in good engineering common sense to get the best results with a freedom of methods so successful in the best types of so-called "Western" practice and without a feeling that it is necessary to follow precedent which at other places and under differing conditions might be good practice, but which has been the cause of much financial waste and indifferent engineering results in other points on the Pacific Coast as well as elsewhere.

It is proposed, in this article, to describe the power plants and distributing systems, leaving the transmission line as being of sufficient interest to form the subject of a separate and special article.

Storage Reservoirs.

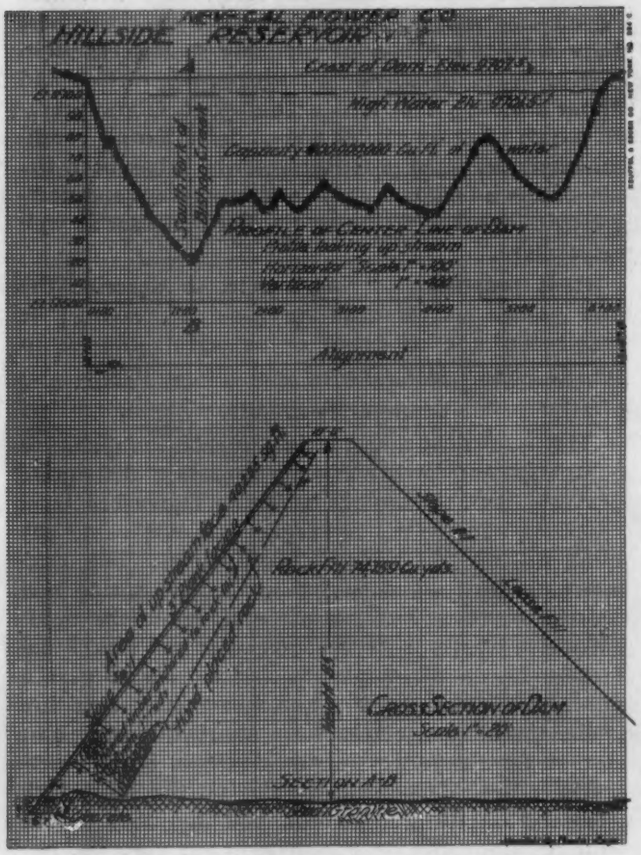
The watershed area of Bishop creek available to the storage and power system is about 39 square miles and lies between the altitudes above sea level of 9,000 and 13,000 ft., the higher altitude being the summit ridge of the Sierra Nevada range. The maximum flood flow which occurs in the late spring will ordinarily reach 500 cu. ft. per sec., while the minimum which occurs between November and March becomes as low as 30 second feet. In order to give a mean requirement for the power system, there are possible three storage reservoirs above the first point of intake for the power plants. Two of these reservoirs have been developed, the one on the south fork known as the Hillside reservoir and the other on the middle fork, popularly known as Lake Sabrina but officially known as No. 1 reservoir. Both of these reservoirs were natural lakes which nestled at the heads of their respective canyons surrounded by the almost vertical cliffs reaching far above to the jagged minarets and glaciered crevices of the granite peaks. The third reservoir is to be similarly placed in the north fork and upon the completion of this storage, the maximum mean flow possibility available from the watershed will have been obtained.

There is available, coming from the three forks of Bishop creek, and to be eventually first used through No. 1 power plant, a continuous flow of 126 cu. ft. of water per second. It is with this flow capacity in view that the design of the power plants has been made. At present until the north fork storage shall have been created, the maximum minimum flow is about 90 cu. ft. per second, although for a part of each year the eventual maximum minimum of the system is readily available.

Hillside Reservoir.

Originally a deep natural lake, a low dam was built some years ago by the Hillside Water Co., giving a small added capacity. Upon purchase by the present owners this low dam was abandoned and a new and much higher dam was built creating a capacity, includ-

ing that available from the natural lake, of 600 million cu. ft. At some future date it is proposed to increase the height of this dam by 30 ft. The dam is a loose rock fill type, it has a length not including the spillway of 650 ft. and the greatest height is 85 ft. The crest has a width of 15 ft. The downstream face has a slope of 1¼ horizontal to one vertical,



Profile and Cross-Section of Hillside Dam.

and this face is smoothly finished with hand placed rock. The upstream or water face has a slope of ¾ horizontal to one vertical and has a timber lining. In placing this lining, the local lodge-pole pine timbers, peeled and hewed flat on one side, were placed in the rock surface of the dam. These timbers are held in place by 1 in. iron bolts, 6 ft. long and spaced 5 ft. apart. These bolts extend into the structure of the dam and a "U" turn at the extremity of the bolt serves to form an anchor. The timber lining consists of 3 x 12 in. sawn planks laid horizontally and spiked to the timber sills. For the lower one-third of the height of the dam face there are three layers of lining planks, and between the first and second layer is placed a layer of tarred heavy sail cloth to act as a water check. The second third of the face has two layers of planking between which is placed the waterproofing, while the upper third has but one layer, part of which are 2 x 12 in. planks. At the southern extremity a cut through a natural spur in the granite bedrock forms a wasteway, 40 ft. long. A curiosity here presents itself in that the weir edge of the wasteway is a sharp edge of the ledge which broke out while excavating for the wasteway, leaving a natural weir, level and at the proper height.

For the purpose of drawing out the water, there are two 24 in. sheet steel pipes extending from well into the reservoir, and carried through the base of the dam into a small concrete building at the lower toe. This building contains two gate valves by which the water through the outlet pipes is regulated. The building has a heavy timber roof to resist the weight of snow which it may be called upon to carry and the gates themselves are well surrounded and packed with manure to prevent the possibility of freezing. The altitude of the crest of the dam is 9,707.5 ft.

This dam is similar to many rock filled dams in California, and, except for its size might not be of especial interest. The method of getting water out of the natural lake, after its surface has fallen below the bottom of the dam, and the means by which this was accomplished will undoubtedly be of interest.

The Outlet Tunnel.

There is a ridge of rock extending from the center of the dam back toward the center of the natural lake. It was proposed to start a tunnel at a point 600 ft. below the dam in a ridge which is the continuation downstream of the ridge in the lake. It was proposed to carry this tunnel a distance of 2,000 ft., sloping upward 10 ft. in its length and tapping the natural lake at a point 1400 ft. above the dam and at an elevation 65 ft. below its base, practically at the bottom of the natural lake. It was further proposed that this tunnel, being supported on both sides between the hillside, should have a control gate at its lower extremity and hence be under pressure from the lake with a possible pressure head of 140 ft. An interesting problem presented itself from the fact that the tunnel must be put through into the lake and at the same time conserve the water therein which, of course, had no other means of escape.

Work on the tunnel was successfully carried forward in the ordinary manner. At 135 ft. from the entrance, an adit was driven. When the work had progressed until but a few feet remained between the workmen and water in the lake, and when through seams in the granite, water began to percolate, it was deemed the proper point to make the final move. A 36 in. pipe 36 ft. long was laid in the adit and the opening closed around the pipe by a heavy concrete filling. On the end of this pipe was placed a 36 in. gate valve for the control of the water. In the branch tunnel to the adit there was placed a trap gate. This consisted of an iron frame fitted into and cemented in the bore. To this was hinged, so as to swing horizontally from the inside, a heavy steel door. This door was held open against the roof of the tunnel by a wire rope run over a pulley fixed in the roof of the tunnel and then through a 1 in. pipe cemented into the ceiling wall past the gate frame, thence over another pulley through a small vertical shaft to the surface where a winch was set to wind the rope and raise the trap gate. At the lake end of the tunnel a cross gallery was cut and after very carefully calculating the amount of rock to be moved, on the assumption that it was solid, and

giving an ample factor of safety, the galleries were loaded with part 40 per cent dynamite and the remainder black blasting powder. The tunnel was then tamped to a thickness of 20 ft., using the muck of the excavation. In order that the tamping would be loosened and removed to prevent its clogging the tunnel after the blast, a considerable charge was placed with the tamping and timed to fire slightly after the main charge. The charges were wired for battery firing and were also fused, the fuses being carried through the tunnel. The gate valve was opened and the trap valve was also raised and the man in charge of the latter was instructed to listen at the mouth of the adit, after the explosion had taken place, until he could hear the rush of water and then to immediately spring the trap valve and close the gate valve as soon as the water should start. The battery firing was successful as well as the firing of tho tamping charge. The trap valve was closed and the tunnel was put through into the lake. The opening was so thoroughly made, however, that it became necessary to erect a considerable timber structure at the mouth of the tunnel to support emergency gates placed there in case the tunnel or outlet gates should for any reason fail.

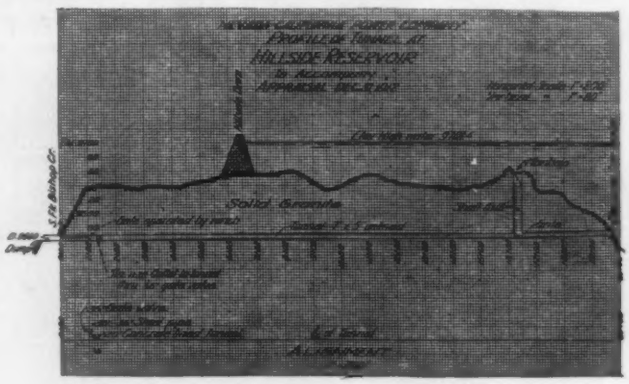
No. 1 Reservoir.

No. 1 reservoir, locally known as Lake Sabrina, was the first completed with a dam. Situated very much as is the Hillside reservoir but on the middle fork, its elevation is somewhat lower, being 9,079 ft. at the crest of the dam. The dam here has a length including the spillway of 1,065 ft. and a maximum height of 75 ft. The construction of the dam is similar in every respect to the one already described. The spillway is of concrete, it has a length of 40 ft., and the weir has an ogee section. Three 24 in. steel outlet pipes terminate in gate valves at the lower toe of the dam and these are placed within a concrete building similar to the one described. There is no outlet to the natural lake as is the case with the Hillside reservoir.

It is with the outlet pipes of this dam that the flow line for the first power plant is to commence and this flow line, which, following the precedent in the entire design of this system, will consist of wood stave pipe and will be carried along the south hillside of the middle fork to a point near where the south and middle forks join. Here a pressure pipe diagonally down the hillside will connect with the first powerhouse of this system.

No. 1 reservoir when full covers an area of 159 acres, and the capacity is 300 million cu. ft. The dam contains 50,000 cu. yds. of rock fill.

The Hillside reservoir is about seven miles above the junction of the south and middle forks, and its water will be carried from the dam outlet through a wooden pipe flow-line along the north slope of the south fork to a point where it may be dropped through a pressure pipe to proposed plant "A." From the tailrace of this plant the flow will continue through a wooden pipe line to plant No. 1. This plant will necessarily have two pressure pipe lines as the head available from the No. 1 reservoir will be 950 ft., while that on the Hillside pipe will be 850 ft. At the present the "A" and No. 1 plants are the only ones of the total of seven plants possible on the creek which have not been developed. The elevation of No. 1 power house will be 8,050 ft., making it the highest



Profile of Hillside Reservoir Tunnel.

in point of altitude of any Pacific Coast plant. At present, water from the Hillside reservoir runs down the South fork to a simple diversion and from this point is carried in a steel pipe line, 8,000 ft. long, being part 34 in. and part 38 in. diameter, discharging into the forebay reservoir of No. 2 power plant.

The Power Plants.

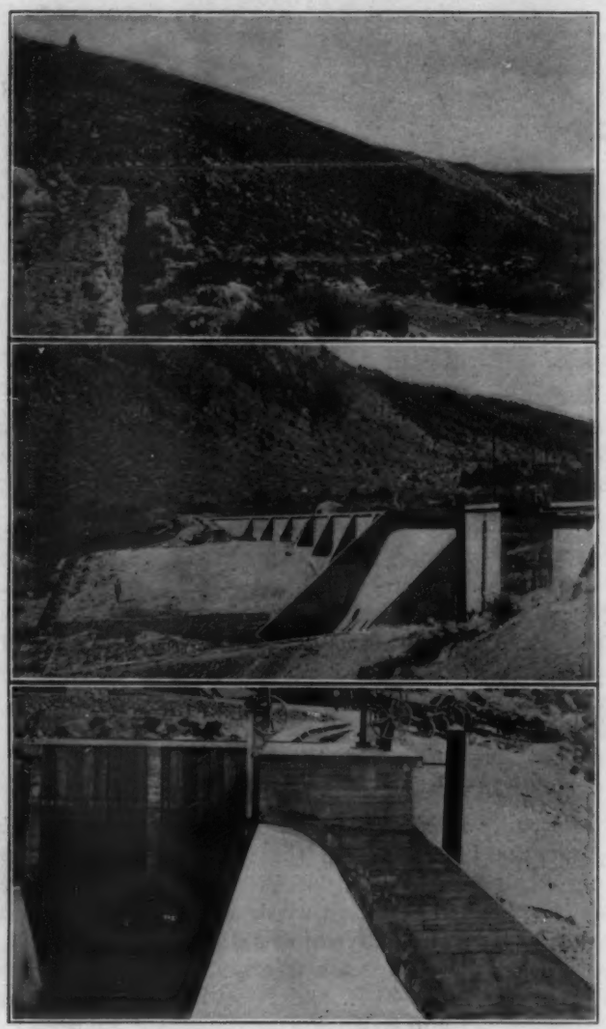
The first plant to be completed by the Southern Sierras Power Company has been No. 6, which was placed in operation in March of the present year. Simultaneously No. 3 has been developed and was placed in operation about one month after No. 6. There now remains, as already stated, but one, No. 1, to be developed, although still higher up there is a possibility of installing a small plant, which, if built, will be known as plant "A".

Beginning at a point in the middle fork, somewhat above the junction with the south fork, and where the No. 1 power house will be placed, there has been built across the creek an earth fill dam with concrete core wall. In the center of this dam is a concrete ogee weir having at its toe a water cushion. The weir has a length crest of 40 ft. and is 30 ft. high. The dam forms a pond and balancing reservoir for No. 2 plant. The intake consists of a concrete box set somewhat back from the dam within the reservoir. This is open at both ends, each opening being covered by a screen of vertical steel bars, ¼ in. thick and 3 in. wide, placed side by side and spaced 1 in. apart. The conduit line to plant No. 2 is carried through the dam and enters the intake box, its opening being controlled by a sluice gate operated from above through a bevel hand gear. At both ends of the concrete spillway, level with its lowest point, are sluice openings controlled with 36 in. sluice gates, operated from the top of the dam through inclined stems.

A peculiarity of this system is found in the fact that the water is carried entirely in either gravity flow or pressure pipes, there being no open canal, ditch or tunnel as is the case with almost any other California power system. This has been done for the threefold purpose of conserving water, getting the benefit

of regulation from the intake reservoirs and the prevention of introducing snow or ice in the conduit lines, a very necessary precaution in this high altitude.

The No. 2 conduit system consists of 10,025 ft. of 48 in. redwood stave pipe. This pipe is formed from 5½ x 1⅝ in. timber and is held together by ½ in. round bands. The pipe is laid approximately to the hydraulic grade when passing the full quantity



Flowline of No. 2 Power Plant.
Intake of No. 2 Power Plant.
Concrete Ogee Weir.

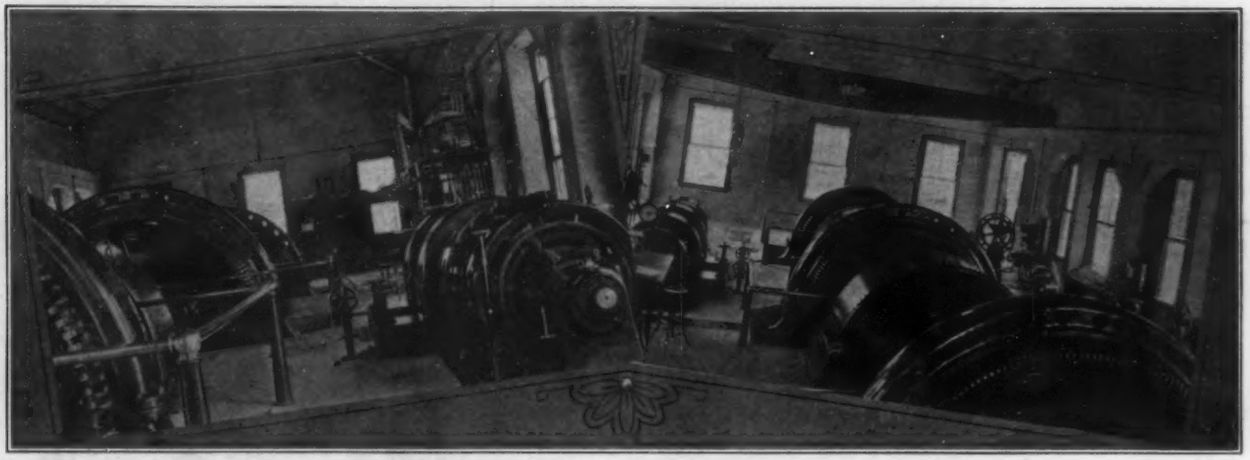
of water, and has a static head to the end of the flow section of 70 ft. In laying, the side hill was carefully benched off and leveled and after finishing, dry rock walls were built on either side and the pipe was covered with earth, at least one foot thick all around. This has been found sufficient to prevent freezing and at the same time keeps the pipe damp and prevents decay to any appreciable extent. This pipe was furnished by the Redwood Manufacturing Company. The stave pipe ends at a point where its grade brings it to the top of the ridge. The pipe is now continued down the side hill to power house No. 2. The pressure pipe has a diameter of 48 in., the lower part is butt and strap riveted and the thickness varies from 3-16 in. at the upper end to 7-8 in. at the power house. There are a number of concrete anchorage blocks. At the junction between the wood stave and the steel pressure pipe, there is placed a standpipe. This is of riveted sheet steel, 3-16 in. thick, has a diameter of 48 in., and a height of 80 ft. It is strongly guyed and an iron ladder is fastened to it by which the top may be readily reached. The static head at the water wheel nozzles is 938 ft.

It should be noted that throughout, while building materials, especially cement, has in no way been stinted, the various structural designs have been carefully worked out to give a maximum of strength and efficiency with a minimum of material. This is due to the high cost of the latter, there having been times when it was necessary to haul cement, a bag at a time on a sled, three or four men furnishing the tractive power.

No. 2 powerhouse, in its design, represents a style of construction and finish characteristic of all of the plants with the exception of No. 5. The building is of reinforced concrete. There are four columns on each longitudinal side of this construction, these extend inside of the walls and support the crane rails, also of concrete, and extend without the walls to give a buttress effect. Curtain walls between the columns are 6 in. thick. The end walls have two buttressed columns and the walls are carried to the gables, which are finished above the roof in a simple style of the Spanish rennaissance. The roof is supported on three Fink steel trusses, the purlins being "I" beams spaced rather closer than usual and carrying a steel Spanish tile roof. The powerhouse layout is very simple and consists of three main generating units placed with their shafts in a line lengthwise of the building. The generators furnished by the Westinghouse Electric & Manufacturing Co., are rated at 2,000 kw., and deliver three-phase current at 2200 volts. The speed is 300 r.p.m. The generators are mounted in pits and there are but two bearings, the waterwheels being overhung. One of these machines installed at a later date than the others is of slightly different type, being somewhat more refined in outline and the rotor hub being made of built up steel plate. The two earlier units are driven by single runner Pelton water wheels, each equipped with needle deflecting nozzles controlled by hand operated worm-gear hand wheels. Pelton governors with self contained oil tanks control the nozzle movement and are operated, each by a 3 h.p. 300 r.p.m. General Electric induction motor. On the feeder pipes which enter the building at an angle below the floor, there being one for each unit, are Pelton gate-valves operated by reversible water wheels. The third unit is driven by a Doble wheel, also equipped with needle main and auxiliary nozzles. A Doble 22 in. gate valve driven by a reversible motor controls the water flow and a Lombard type "Q" governor controls the nozzle mechanism. A Lombard automatic oil pump driven through a Morse chain by a General Electric 5 h.p. 900 r.p.m., motor furnishes oil under pressure to the governor.

Placed in front of two of the main units and with their shafts in line are the two exciter units. The generators in both cases are Westinghouse, 100 kw.,

6-pole d.c. machines, operating at 580 r.p.m., and delivering current at 125 volts. The waterwheels are Pelton single overhung runners with hand operated needle nozzles and cast iron housings. One of the units has a Westinghouse 140 h.p., 2200 volt induction motor placed between the water wheel and the generator, there being one bearing between the water wheel and the motor and another at the far side of the generator. With the first unit the two generator bearings furnish the only shaft support. A single cylinder air compressor driven by a 3 h.p. induction motor furnishes compressed air for cleaning. The switchboard is placed at the middle of one side of the building facing the main units. It consists of three generator panels and an excited panel of blue Vermont marble and a detached panel controlling the exciter motor. Westinghouse standard round type instruments are mounted on the panels and on arms at either end of the switchboard. The generator switches are mounted on the back of the respective panels. All wiring is carried in ducts under the floor.



Interior Views From Opposite Directions in No. 2 Powerhouse.

No. 2. Powerplant, Showing Powerhouse and Transformer House; Flowline and Standpipe on Top of Hill; No. 3 Intake in Foreground Under Construction.

The transformers are housed in a separate building of similar construction to that of the power house. It is 63 x 25 ft. and is placed at right angles in relation to the main building. Within the building, mounted on concrete rails about 18 in. above the floor and placed in a line are 7 1,000 kw. Westinghouse oil insulated and water cooled raising transformers, one being a spare. These are wound for 2200 volts primary to 30,000 volts secondary and are star connected

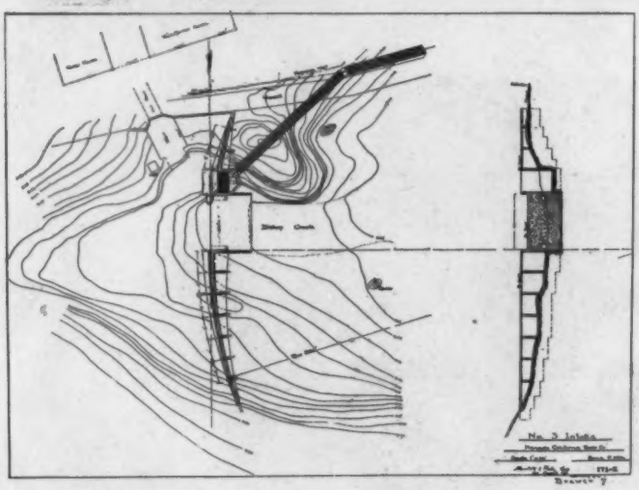
on the high tension side for 55,000 volts. Paralleling the line of transformers is a track on which runs a transfer car onto which any transformer may be moved and transferred. This method of handling transformers is consistently maintained at all points of the system.

Two sets of Pacific Electric Company's 60,000 volt oil switches are mounted on reinforced concrete platforms placed over the transfer track and from these the lines pass through window openings to the pole line of the Nevada-California system.

The water discharge from this plant from a tail race under the power house floor passes directly to the pond in the creek bed created by the dam and intake for the No. 3 installation. The elevation of this intake is 7,093 ft. above sea level.

Power Plant No. 3.

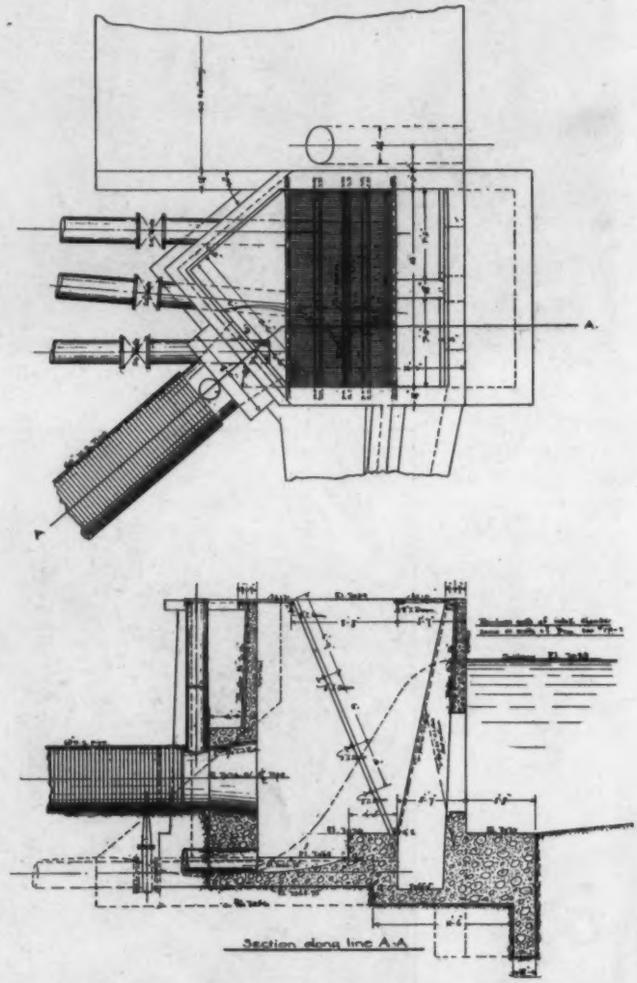
The intake dam, which, at the present is nearing completion, except that it is somewhat smaller, due to the narrowness of the creek at this point, will be like the three intake dams for the plants lower down, to be later described.



Plan and Elevation of No. 3 Intake Dam.

Like No. 2 pipe system, the No. 3 pipe is a redwood stave construction, but somewhat larger, being 60 in. inside diameter. The bands are 5-8 in. The flow section has a length of 13,500 ft. and is packed in earth with a rock siding similar to No. 2 pipe. The grade is 4 ft. per 1000 ft., giving the greatest static head as 64 ft. At the end of the wood section is a riveted steel standpipe, 54 in. diameter and 80 ft. high. This has an iron ladder to its upper extremity and is thoroughly braced with steel cables. With a flow of 150 second-feet, the pipe lies at the hydraulic grade. At a distance of 12,000 ft. from the intake there has been placed a surge pipe laid at right angles following the slope of the hill above the flow pipe, which is about 30 degrees with the horizontal. This surge pipe has a diameter of 60 in. and is built of 3-16 in. and ¼ in. steel plates. The pressure pipe has a length of 4630 ft. It is of riveted and butt and strap riveted steel in three diameters. At the upper end the pipe has a diameter of 54 in., and a thickness of 3-16 in. The diameter reduces to 50 in., and finally to 48 in., the thickness at the bottom being ¾ in. The static head at the water wheels is 814 ft., while the effective head under full load is 730 ft.

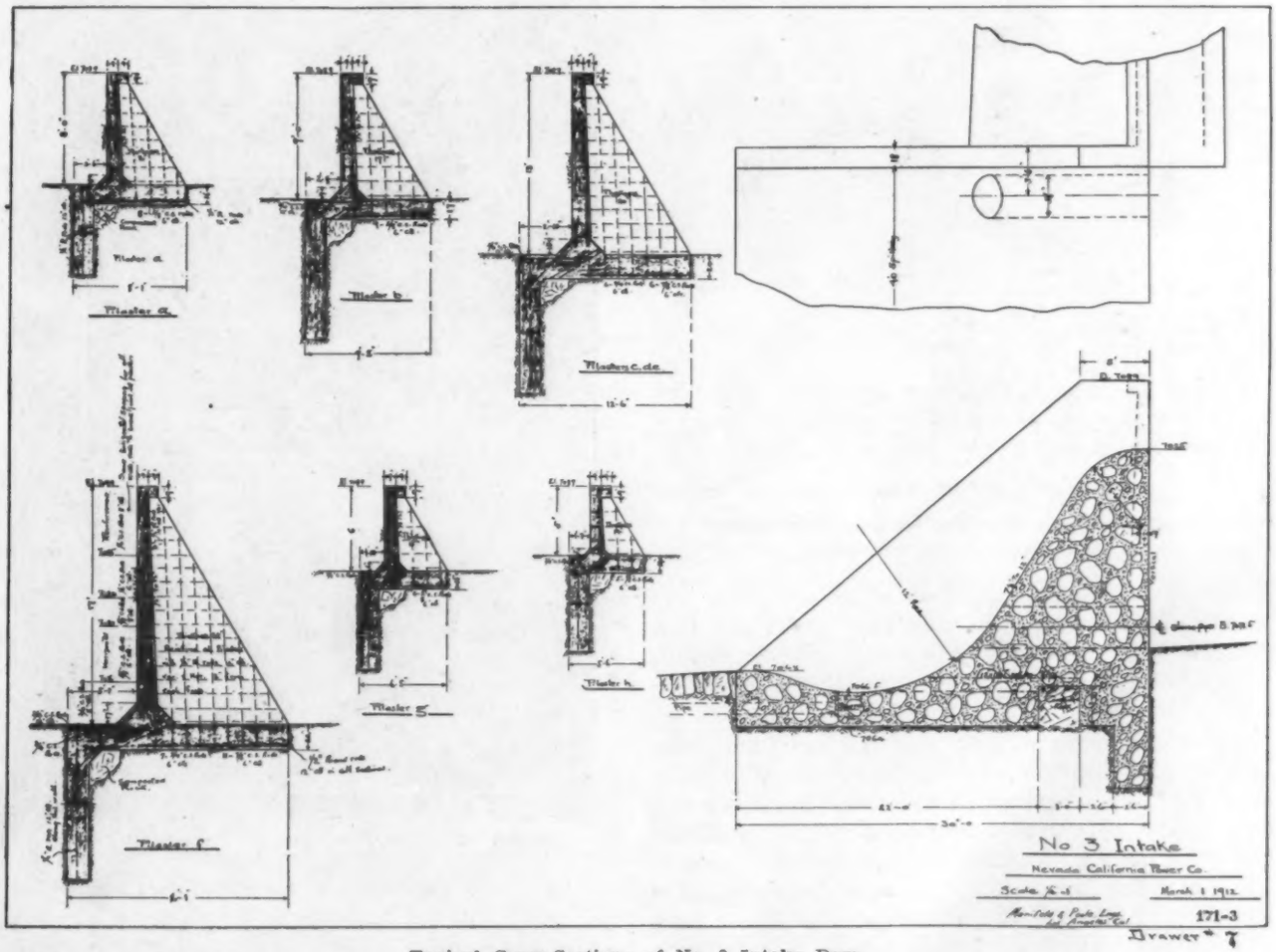
The No. 3 powerhouse is almost a replica of No. 2, both in the laying out of machinery and in the style and type of building. The dimensions of the building inside are 38½x82 ft. There are five pilasters, including the corners on each side and two in each end, and the roof is supported on four Fink trusses and consists of galvanized corrugated iron, with two round ventilators in the ridge. There are



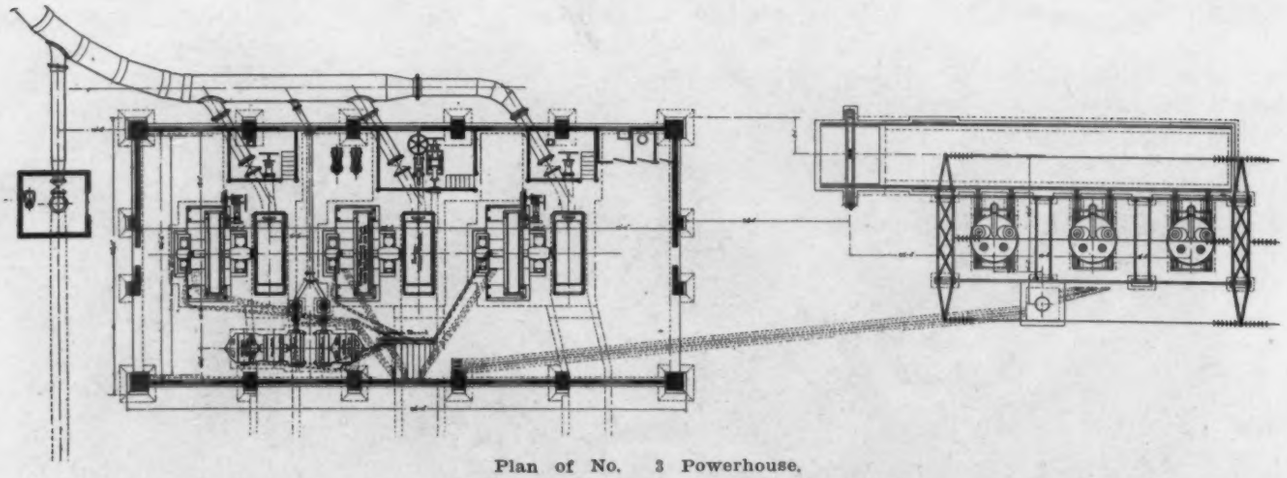
Intake Box for No. 3 Powerhouse Pipeline.

three main generating units, each having a rating of 2250 k.v.a. The generators are Crocker-Wheeler, two bearing, 3-phase, 2200 volt machines operating at 300 r.p.m. They are driven by single overhung runner waterwheels known as the "Henry" type, designed and built by Geo. J. Henry of San Francisco, formerly engineer for the Pelton Water Wheel Company. Stationary needle nozzles are operated on the two end units with hand control. On the middle unit, the needle is operated by Henry's patented automatic, oil-pressure operated control and in conjunction with this is a similarly operated automatic bypass. These automatics obtain their movement by a cylinder mounted in line with the nozzle and bypass pistons, in which oil under a pressure of 100 lbs. is supplied from a water operated pair of steam pumps with necessary reservoirs, piping, etc.

No. 3 Power Plant. Flowline Is Shown in Center Background, the Flowline for No. 2 Plant Is in Left Background.

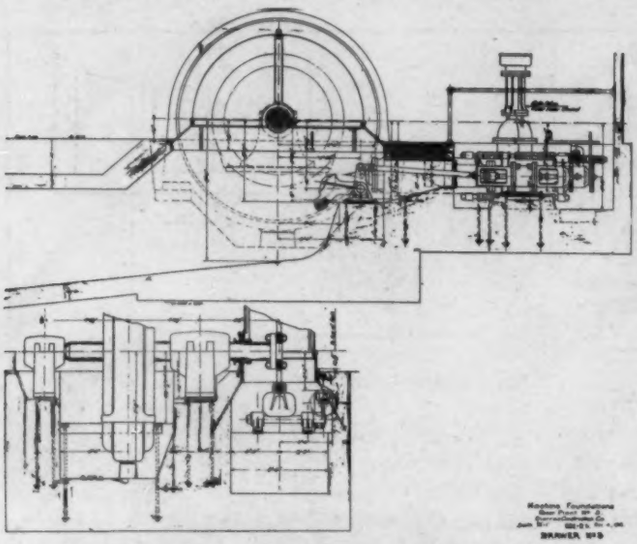


Typical Cross-Sections of No. 3 Intake Dam.



Plan of No. 3 Powerhouse.

It has been the policy of this company to avoid automatic regulating devices both on the hydraulic and electrical parts of the system, with the exception of the speed regulating governors. The water flow variation is but slight from day to day and in operating the chain of plants practically no sudden change can be made in the water quantity. For this reason there is little need for the added expense of automatic hydraulic regulation. No. 3 being the most modern plant, an automatic water saving device was installed on one unit to be used only in the case that through some interruption the flow might be materially reduced and the saving of water at this point become a necessity.



Cross-Section and Elevation of Main Generating Unit at No. 3 Powerhouse.

The governors on units one and three are Lombard type "M" which operate balanced deflecting hoods over the nozzle streams. On the center unit is mounted a Woodward governor which operates in conjunction with the automatic nozzle and bypass described.

There are two exciter sets placed in line with the switchboard close to the building wall. These have Crocker-Wheeler, 6-pole and interpole, 125 volt d.c. generators operating at 580 r.p.m. and are driven by single runner overhung Henry water wheels equipped with hand regulated needle nozzles. One of the units is quipped with a 150 h.p., 2200 volt, 3-phase, Crocker-Wheeler induction motor between the water wheel and the generator, and connected to the latter through a bolted coupling. Both units have two bearings.

Interior of No. 3 Powerhouse: Underneath View Showing Coil Ends and Insulation of Westinghouse Transformer at No. 3 Powerhouse. Henry Waterwheel on Main Unit, No. 3 Powerhouse.

On each of the main feed pipes, which enter the building on an angle below the floor level, are 24 in. steel gate valves operated by reversible water motors. These gates were built by the Main Street Iron Works of San Francisco.

The switchboard in five panels was furnished by the Crocker-Wheeler Company and is equipped with Westinghouse instruments and Condit oil circuit breakers mounted separate from and in the rear of the switchboard. These switches are equipped with time limit relays and automatic trips. These features are, however, disconnected and not used in operating the plant.

suspended from the cross beams. By means of this device a transformer may be let down into the pit and the core removed or inserted as the occasion may require. Over the transformers is erected an extensive angle iron framework. Opposite each transformer on the rear side are mounted on the framework the high tension disconnecting switches and on the front one those for the low tension circuits. On top of the frame is a set of 3-pole Bowie air break switches with hand control from below. From these switches the circuit is carried to a three wire steel "Wishbone" pole line which goes to the control station at the mouth of the canyon.

General View of No. 4 Powerplant.

The oil pressure system, which is novel, is operated by two Dow steam pumps with cylinders 6x4x6 in., having enlarged ports and using water from the auxiliary pipe supplied from a redwood tank which in turn is filled through an automatic valve from the main pipe line.

This plant will be operated on the system of the Southern Sierras Power Company and the transformers and high tension apparatus follow the standards adopted. All of this apparatus is "out-door" type and is placed adjacent to the power house. There are 3 Westinghouse, water-cooled transformers wound 2200 to 87,000 volts and to be star connected on the high tension side for 140,000 volts. These are mounted on I beam trucks with 12 in. cast iron wheels and stand on raised concrete platforms. A steel transfer car on an 8 ft. gauge track parallels the transformers. At the end of this track is a concrete lined pit, 16 ft. deep, over which is a steel gallows frame made of 6 in. H beam columns and two 15 in. I beam cross bars with corner braces. A hand winch operates a wire rope tackle with double 3 sheave blocks,

The discharge from this station, like No. 2, is into the forebay pond formed by the concrete dam of No. 4 intake. The elevation of this intake is 6,220 ft.

Power House No. 4.

Approaching the canyon from the town of Bishop, one rides some four miles between rich fields of alfalfa and more directly between stately rows of poplars before the first slope which is soon to rise very abruptly toward the mountain peaks, is reached. Another mile and the chauffeur (if you are so fortunate as to be riding in an auto.) puts in the intermediate gear, although the country looks fairly level, but the trees are missing and the granite boulders are thick among the clumps of sagebrush. The canyon is entered between two abrupt hills that would look very high were they not dwarfed by the snow covered peaks which seem to rise directly behind them. About a mile ahead as one looks up the canyon there appears a large and picturesque group of buildings, their red and green roofs interspersed with trees and shrubbery, a very bright and inviting spot nestled into a

turn of the towering canyon. One might easily imagine it to be a well ordered summer watering place. The grounds are entered through a quaint lodge gate and the macadamized and concrete parapeted road lined with tasty electroliers divides, passing around both sides of the canyon to meet in a wide sweep above the buildings. The creek, rocky and precipitous, has been confined between heavy concrete walls, as is done in the Swiss Alps, and where it widens in the center of this settlement, a sort of sunken garden, a triumph of the landscape artist, forms an island which dips into the little lake below it. And all this, because in its midst is No. 4 power plant, the first and oldest in this remarkable chain of plants.

The concrete dam which forms the intake for plant No. 4 is representative of the type of dam used throughout, although not so modern in some minor details as the dam for No. 6 plant, described later. The dam consists of a reinforced concrete vertical wall 12 in. thick at the top, increasing downward to 15 in. On the top is a coping 18 in. wide, being flush with the wall on the upper side. The dam is supported from overturning by triangular buttresses 12 in. thick with a 2:1 slope on the buttress face. The buttresses are spaced about 20 ft. apart. In the center is an ogee spillway having a crest 24 ft. above the bottom and 50 ft. long. The height of the dam coping is 29 ft. Placed in the dam between the spillway and the north end is a concrete intake box. This is open at one side, the opening being covered with a sloping grizzly of 3x¼ in. steel bars placed on edge and spaced 1 in. centers. There are two 5 x 5 ft. sluice gates to control the flow into the pipe. Directly in front of the pipe opening inside the box is a flat iron gate hinged to one side of the pipe and operated by a worm gear and hand wheel. This is called a slap-gate, and in case of emergency, by pulling a pin, the force of water will slam this gate closed over the pipe opening. The usual pair of drain gates are also provided at either end of the weir.

The flow line is a 42 in. redwood stave pipe 6700 ft. long. From this two steel pipe lines are carried to the powerhouse by different routes. The first pipe installed is 24 in. diameter and is 5,000 ft. long. This pipe is lap welded steel and was imported from Germany. It varies in thickness from ¼ in. at the top to ⅝ in. at the power house. There is a 12 in. standpipe 65 ft. high at its upper end. The newer pipe was given a different route, keeping well away from the first for the sake of safety and thus has a greater length. This pipe is riveted sheet steel, the lower sections having butt and strap joints. The diameter is 30 in. and the thickness varies from 3-16 to ⅝ in. The pipe is well anchored by cyclopean concrete blocks placed in the construction bell holes. There is a 30 in. standpipe at the top. This pipe was built by Schaw, Batcher Co., of Sacramento. Close to the power house the pipe lines are connected through a small header, but the water wheel connections are made directly from the branches in either line. The effective head at the water wheel nozzles is 1,050 ft., while the static head is 1,120 ft.

The power house building, while it has been added to to accommodate increased capacity, is substantially in construction like those of Nos. 2 and 3, being of reinforced column and curtain wall type, with corrugated iron roof of Fink steel trusses. There is a main bay for the generating units and a gable addition forming a bay almost as long as the main part, in which are placed the transformers. There are five main generating units placed with their shafts in line. The first two units have 750 kw. National Electric Co. generators, operating at 450 r.p.m. and delivering 3-phase current at 2200 volts. These units have two bearings mounted on the castiron generator base frame. The waterwheels are single runner overhung, built by the Pelton Company. They have hand control needle nozzles which regulate by deflecting and are operated by Sturgiss governors. On each intake pipe, which connects to the older pipe line, are hand operated bevel geared gate valves. The remaining three units are 1,500 kw. Allis-Chalmers generators with two bearings mounted on cast iron base. These operate at 400 r.p.m. and like all generators of this system deliver current at 2200 volts. The water wheels are overhung single runners equipped with governor deflecting, hand regulated needle nozzles. The gate valves on the intake pipes are operated by reversible water wheels. While the general specifications of the water wheels on all three machines are alike, two of the water wheels with their gate valves were furnished by Doble, while the third is a Pelton unit. On the new pipe line there is a 30 in. hand-gear operated master gate valve. The three larger units are controlled by Lombard type Q governors. Oil is suppled under pressure for all of the governors by a 3-throw Lombard oil pump driven by a General Electric 10 h.p. induction motor. There are three exciter sets. Two of these have National 60 kw., 140 volt, 850 r.p.m., 6-pole, d.c. generators, with single runner overhung Pelton water wheels equipped with needle nozzles. The latter are controlled by a hand wheel with a left hand screw, installed presumably to insure opening quickly by the natural right hand motion should the nozzle become plugged, but habit and custom are strong guides and this reversal of common practice has at times proved to be annoying if not disastrous. One of these units has a National type I, 90 h.p., 2200 volt induction motor. The third exciter unit has a General Electric 55 kw., 125 volt, d.c. generator operating at 650 r.p.m. with Doble overhung waterwheel having a needle nozzle. The latter is controlled by what is claimed to be the first Replogle governor to be put to regular use. This unit has also one General Electric type I, 75 h.p., 2200 volt induction motor. The switchboard of blue Vermont marble, has five generator panels with oil switches mounted on back, two exciter panels and one voltage regulator panel. A full equipment of Westinghouse instruments follows the general practice of standardizing in use in this system. Back of and above the switchboard, placed on concrete platforms mounted on steel columns, are three sets of Pacific Electric, 60,000 volt oil switches on the high tension circuits from the transformers. There are 7 (one spare) Stanley-G. I., 500 kw. type W., 2200 to 33,000 volt water cooled transformers. Also

3 additional units of same make and capacity, Y connected on the high tension side for 55,000 volts through which the Nevada-California and the Southern Sierras systems are paralleled.

Near the power house is a corrugated iron switch house, 50x35 ft. Two high-tension (33,000 volt) circuits leave one side for the Nevada transmission. One circuit entering each end of the building comes from the power house and a fifth circuit entering the other side connects to plant No. 2. After passing through Pacific Electric oil switches placed on two galleries, the circuits connect to a common bus. Close to the switch house and under the Nevada circuits is a concrete building 30 ft. long and 9 ft. wide, inside measurement, with overhanging roof on one side. This building houses the General Electric aluminum cell electrolytic arresters. The lines to the horn gaps enter the building under the protecting roof through special wall insulators.

There are at this plant a commodious club house and a number of neat and tasty cottages for superintendent and operators and their families.

The elevation of No. 4 plant is 5,156 ft.

Power Plant No. 5.

Mention has already been made of the lake into which the tail water discharging from Plant No. 4 passes, this, as in the plants above, is formed by a

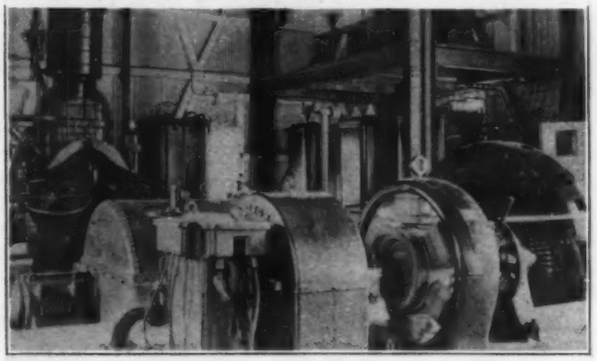
No. 5 Powerhouse and No. 6 Intake.

dam across the canyon which makes the diversion into the pipe line of No. 5 plant. The dam with its ogee spillway weir, intake box, gates, etc., is similar to the one belonging to No. 4 plant, with the difference that it is somewhat longer, and is made of a number of tangent sections to form roughly a curve down stream.

The pipe line, which is covered in the manner typical of this system, is 2,500 ft. long in the flow-line section. This is a fir stave pipe, 54 in. inside diameter. This section terminates at the end of the hill which is in reality the end of the canyon. From this point a riveted sheet steel pressure pipe 42 in. diameter, varying in thickness from 3-16 in. to ½ in., and having a length of 5,500 ft. terminates in powerhouse No. 5. At the top of the steel section is a steel standpipe.

Powerhouse No. 5, which was the second plant to be constructed and is operated in connection with the Nevada-California Company, is a corrugated iron building over a steel frame covering a ground space 40 x 60 ft. It is placed close to the creek, which at this point is between deeply eroded banks forming a ravine or arroyo, and is almost hidden from sight on approaching until one is very close.

There is but one main generating unit with a capacity of 1,500 kw. This is placed in the center of the building, the shaft line parallel with the shorter axis



Interior View of No. 5 Powerhouse.

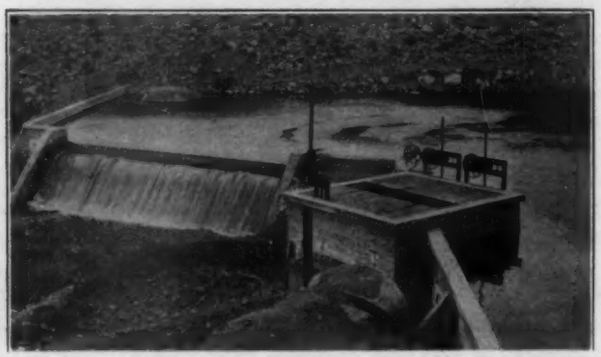
of the building. The generator furnished by the Allis-Chalmers Company is a standard 2-bearing type mounted on castiron base. It delivers 3-phase current at 2200 volts and operates at 400 r.p.m. The shaft is solid through the waterwheel which has an outboard bearing making three bearings to the unit. The water wheel was built by Doble and has two tangential runners, each furnished with needle nozzles which may be hand or governor operated by the movement of a clutch. The 24 in. intake pipes to the nozzles join back of the water wheels through a Y casting with a 36 in. outlet and between this and the pipeline is placed a 36 in. Platt Iron Works gate valve operated by means of a hydraulic cylinder which takes water from the penstock. Formerly the prime mover for this unit was a Francis type water wheel. This proved unsatisfactory in operation from the fact that the water, while apparently clear and pure, carries much glacial sand and the cost of renewing chutes and runners due to the erosion from this suspended matter resulted in the substitution of wheels of the tangential type. A type Q Lombard governor is in place but not always in use, hand control being often preferred as more economical in the use of water, when no regulation from this station is required. There is one exciter set, having an Allis-Chalmers 60 kw., 120 volt, 600 r.p.m., 6-pole, d.c. generator and a single runner, overhung Pelton tangential water wheel in cast iron housing and hand regulated needle nozzle, all mounted on a cast iron bed-plate. The switchboard is in two panels and is of the same general style found in the other plants. In one corner of the building there are 4, Stanley, G-I. 500 kw., water cooled raising transformers, wound for 2200 to 33,000 volts. (One of these is spare.)

One set of Pacific Electric Manufacturing Company's oil circuit breakers are installed over the transformers on a reinforced concrete platform. No. 5, like the preceding plants, discharges into a pond formed by diverting dam for power house No. 6.

The operating hydraulic head on No. 5 plant is 420 ft. The altitude of the powerhouse is 4,730 ft.

Power House No. 6.

It has been already stated that No. 6 and No. 3 were plants operated by the Southern Sierras Company and were the newest plants, both having been built at the same time. No. 5 is well away from the foothills and the ground surface from No. 5 to No. 6 is a gradual slope, the latter plant being at the edge of the valley floor. The intake to No. 6, while like the other intakes in style and design (except No. 2, which is earth with concrete core) is new and from the engineers' standpoint has a good deal of style. The dam wall is 10 in. thick with an 18 in. coping on top, flush with the upper side of the wall, and the buttresses, which are 12 in. thick, are spaced 15 ft. apart.

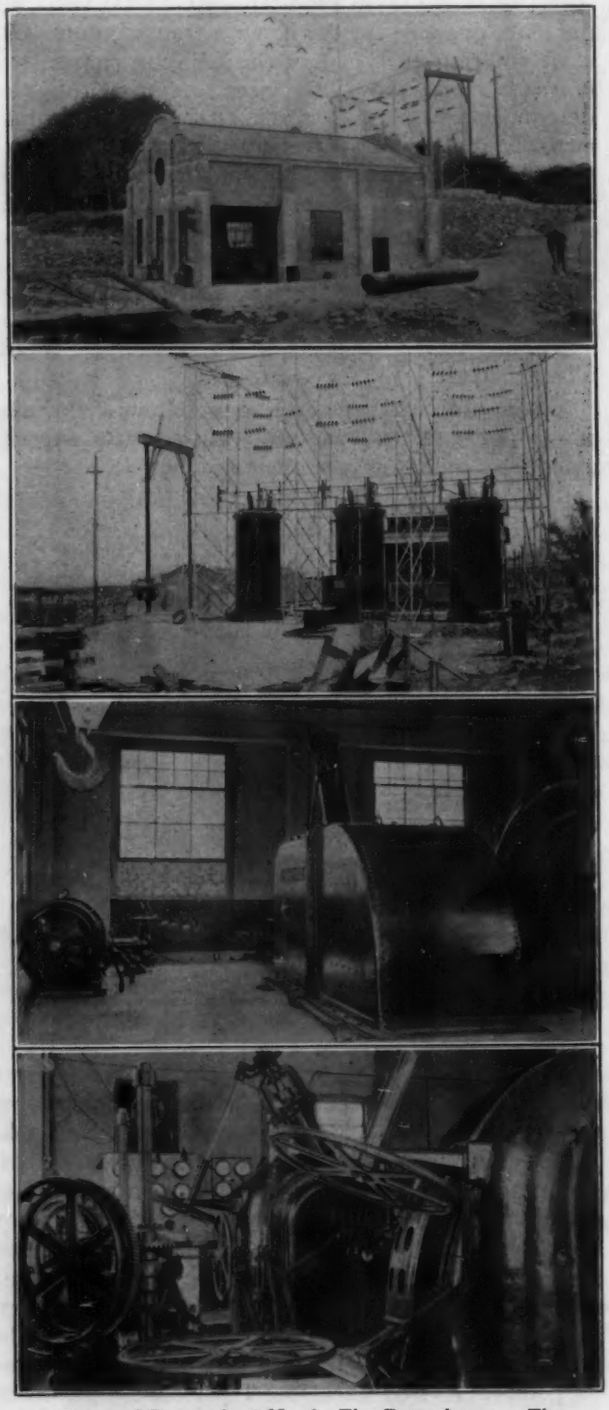


Forebay Reservoir and Intake for No. 6 Power Plant.

The dam, which is 300 feet long, is not straight, although the axes of the two end lengths are about parallel and the intake box, which is of concrete, being in line with the pressure pipe is set skew with the wall. In this box, the sloping screen is inside the box while the two entrance sluice gates cover the back wall. The spillway has an ogee section but has also fitted to its crest a removable flashboard 30 in. high. This is held in place by 1 in. sloping iron braces, fastened into the crest of the weir. The total height is 15 ft.

The pipeline is of wood stave construction for a length of 3,000 ft. It is 60 in. diameter. The staves are redwood cut from 2½ in. stock which finishes to 2⅛ in. thick. This pipe was furnished by the Pacific Tank and Pipe Company. The remainder of the pipeline is riveted steel 54 in. diameter and varying in thickness from 3-16 in. to ⅜ in. This section has a length of 4,700 ft., giving the pipeline a total length of 7,700 ft. Throughout its length the pipe is laid in a trench, the depth of which is equal to about the diameter of the pipe, but the latter is nevertheless covered thoroughly with earth and hand placed rock.

The powerhouse building of No. 6 measures 30 x 42 ft. inside and is a replica of Nos. 2 and 3, although smaller than either one. The operating hydraulic head is 258 ft. and like No. 5 there is but one main generating unit. This plant is very simple in design and in operation and particularly suitable to a system of the sort to which it is connected. The main generating unit is placed at the center of the building, its shaft parallel to its greatest length. The generator rated at 2000 k.v.a. was built by the Allis-Chalmers Company. There are two pedestal bearings mounted on the concrete foundation, the armature ring being carried on sliding floor plates. The unit has a star connected armature giving 2200 volts and the speed is 164 r.p.m. This low speed was selected, notwithstanding the requirement for a heavier generator, to permit of



Views of Powerplant No. 6: The Powerhouse. The Transformer Station, a Transformer Water Coil Is at the Left. The Main Generator. One of the Pelton-Doble Waterwheels, and the Exciter. Gate Valves and Switchboard.

a sufficient waterwheel diameter to efficiently handle the large streams necessary in using but two runners. The waterwheels are mounted on either end of the generator shaft and are housed in cast iron cases. Each wheel has two needle nozzles, the one horizontal

delivering its stream at the lowest point of the wheel, while the other points downward, its delivery pipe being carried up from the main feedpipe through a large cast iron gooseneck. The needles in the nozzles are controlled, each by its own hand wheel. A Lombard type Q governor controls the unit by operating deflecting hoods over the nozzle tips. The usual motor operated oil pump supplies the governor with oil under pressure. Cast on the sides of the waterwheel casing is the compound name, Pelton-Doble, which shows that somebody got history inverted when he constructed the old adage, "the best of friends must part." To supply water to the nozzles a Y casting at the end of the pressure pipe connects to two feeders 30 in. diameter and in these are placed reversible waterwheel operated cast steel gate valves. The exciter in one unit is placed at the opposite end of the building from the switchboard. It consists of a four-pole (with interpoles), Allis-Chalmers, 120 volt 50 kw., d.c. generator, operating at 860 r.p.m., one 66 h.p., 2200 volt induction motor of the same make, driven by a two-runner, needle nozzle, Doble-Pelton water wheel with gate valves of the same make. The nozzle needles are operated from a stand in front of the switchboard, connection being made and motion transferred through an endless bicycle chain running over sprocket wheels fixed to the valve spindle, the chain passing over both sprockets and turning them simultaneously. The switchboard is of marble with Westinghouse instruments. There is one generator panel, one exciter panel, narrower than the first a short General Electric type T. A. voltage regulator panel, one swinging panel and placed at right angles a panel for the exciter induction motor. The generator circuit breaker is mechanically operated remote control, General Electric, type K-12.

The transformers and high tension switching apparatus are placed on high ground adjacent to the powerhouse. There are three Westinghouse 750 k.v.a., water cooled, outdoor type raising transformers. These are wound for 2200 volts primary and 87,000 volts from the secondary, there being taps to give lower voltages for connection to the present system using 55,000 volts. These transformers with star connection deliver 140,000 volts. The arrangement of the disconnectors and high tension switches is the same as at power house No. 3.

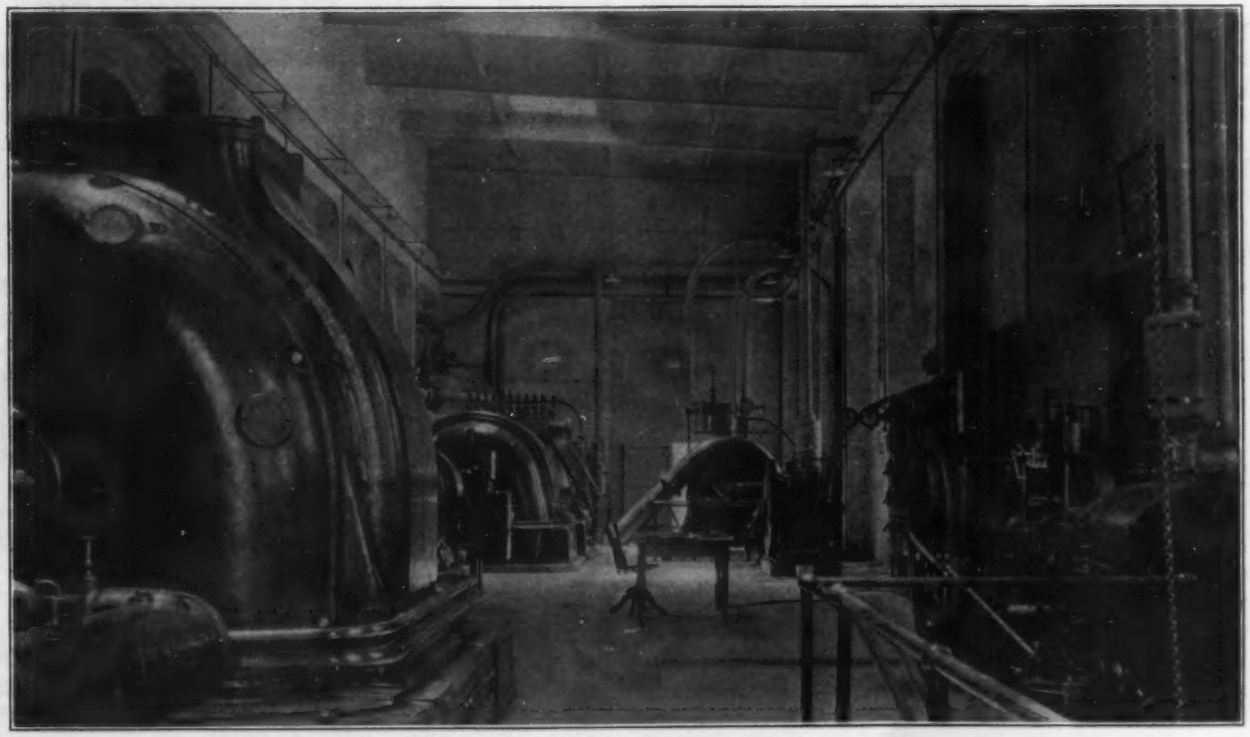
Throughout this system of power houses all switches are hand operated and as before stated no automatic devices are used except governors.

All of the power houses are provided with hand operated traveling cranes of 20 tons capacity, these cranes having been built by the Cyclops Iron Works of San Francisco.

Auxiliary Steam Plant at San Bernardino.

Placed on a tract of ground covering about two acres, adjacent to the track of the Atchison, Topeka & Santa Fe Railway, on the outskirts of the city of San Bernardino, this plant represents a most satisfactory example of modern steam practice, with some features, including simplicity and roominess, for which it deserves especial study.

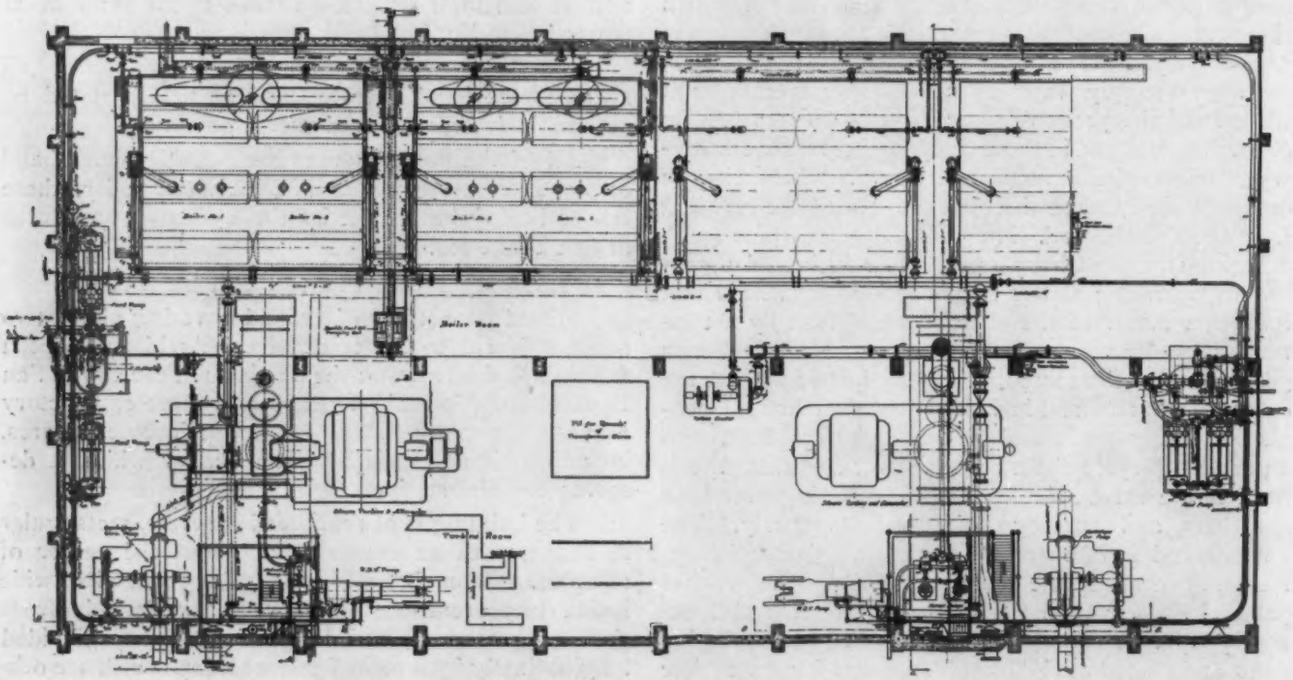
The building is of reinforced concrete, rectangular in shape, with an extension at about the center of one side. The main part is 132 ft. long and 64 ft. wide inside measurement, while the wing extends from the main part about 40 ft. There are two bays, divided longitudinally by a row of columns, but which are otherwise open to each other. The roof and crane runways are supported on heavy reinforced concrete columns, while the walls of the same structure have a



Interior View of San Bernardino Steam Generating Station.

thickness of 10 in. steel I beams support a concrete slab roof which is nearly flat.

All of the machinery, auxiliaries and boilers are placed on the main floor, the boilers in a line in the more southerly bay, their fronts facing the other half of the building and being open to it. The main generating units stand, their shafts in line as close to the center columns as the space and convenience will permit, while the auxilaries are placed more or less close



Plan of Layout, San Bernardino Steam Generating Station.

to the more northerly wall, leaving a wide and commodious space or runway throughout the length of the building. The switchboard is also on the main floor level and is placed flush with the north wall at the center of the building and behind this is the building extension in which are placed in three floors, switches, busses, rheostats, and transformer repair shop. This arrangement concentrates in a comparatively small space, all of the essential apparatus of the plant giving the greatest ease of access by those in charge and requiring the least effort and consequently a reduction in the running force to a minimum consistent with safety.

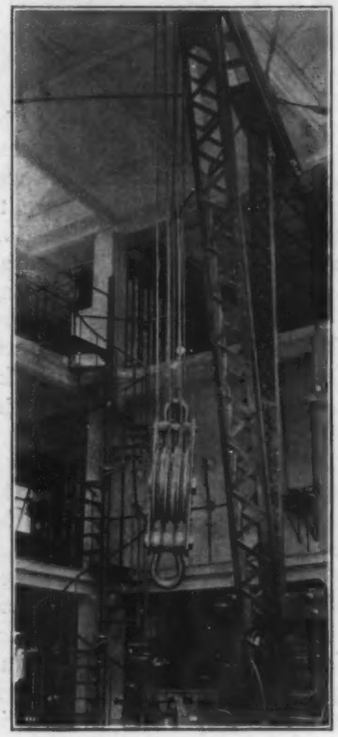
The boilers are arranged in pairs with the exception of the last set which has but one boiler and there are seven boilers in line. These are Stirling, Class O, and are rated at 501 boiler horsepower. Each boiler contains 360, 3½ in. tubes which terminate at the upper extremity in three 42 in. drums, while at the lower end is one 48 in. mud drum. Superheaters are part of the equipment and steam is taken from the side of the pair through the conventional valves, and check valves, there being space between each pair of boilers. The steam connections run in a long curve to the header which is supported against the row of center columns at a height convenient for inspection and repair and also for connection to the turbines. The furnaces are equipped with Hammill oil burners pumps for transfer of oil from the storage tank to the burners. Two steel tanks with a capacity of 2500 bbls. each, receive fuel from tank cars which are run to the tank over a spur from the main line of railway. The boilers, auxiliaries and construction were furnished by the Chas. C. Moore Company of San Francisco.

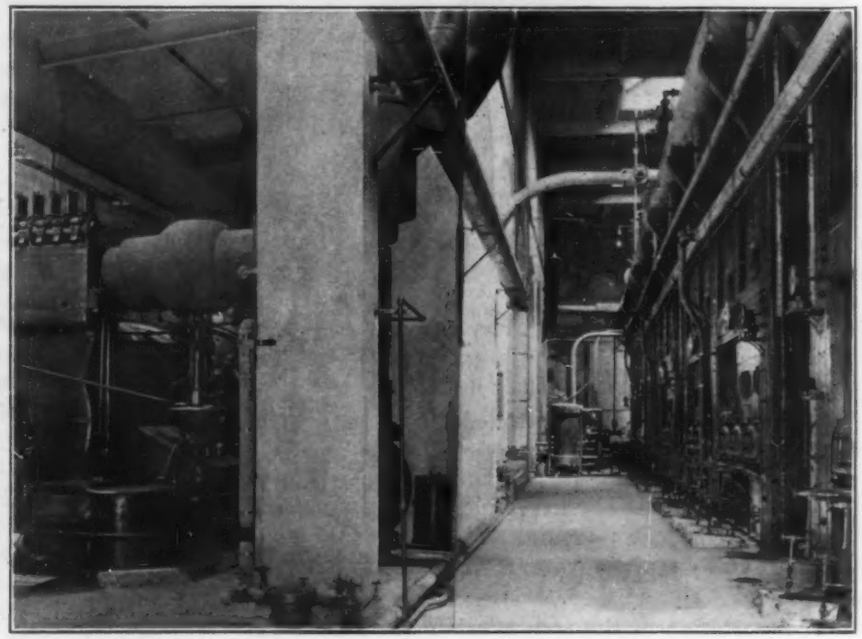
There are two horizontal main generating units. One of these is a General Electric-Curtis, Class 4, form and there is provided the usual equipment of steam L, turbine operating on 180 lb. steam pressure. The capacity of the generator is 5000 kw. and operates at a speed of 1800 r.p.m. The voltage of the generator is 6600. The other unit, the first to be installed, was built by the Allis-Chalmers Company. The turbine is of the standard capacity for a 3000 kw. unit, although susceptible of heavy overloading. The generator has a capacity of 5000 kw., is the same voltage as the other unit and operates at the same speed. A four pole 50 kw. exciter is mounted on the generator end of the shaft of this unit. This exciter has two interpoles. The object of installing an oversize generator was for the purpose of having sufficient capacity to charge the transmission line if necessary, the charging requiring capacity in the generator to maintain the heavy current flow which, under this condition, is leading the voltage, forming a wattless component and thus does not represent true energy. At other times the capacity of this unit is sufficient for certain operating conditions and in the event of an emergency call for power, there is sufficient reserve capacity in the turbine to give the generator full energy load for a limited period.

There are two exciter sets, the one driven by a Curtis non-condensing turbine at 3600 r.p.m., has a capacity of 75 kw. The generator has two poles with interpoles and delivers direct current at 125 volts. The other set is a General Electric motor-generator, the motor, induction type I, is rated at 150 h.p., operates

at 900 r.p.m., and receives three-phase current at 440 volts. The generator, of the same make, is a 100 kw. 6-pole and interpole d.c. mochine.

The auxiliaries, complete for each main unit are duplicates and are grouped at either end of the building extending toward the middle. These consist of Wheeler vacuum pumps, cylinders 9 x 22 x 16 in. Wheeler centrifugal circulating pumps direct driven by Reeves vertical, simple, cylinder valve, 10 x 14 in. cylinders, engines. These units stand on the main floor and while prominent objects of notice are well placed for appearance and convenience of operation.



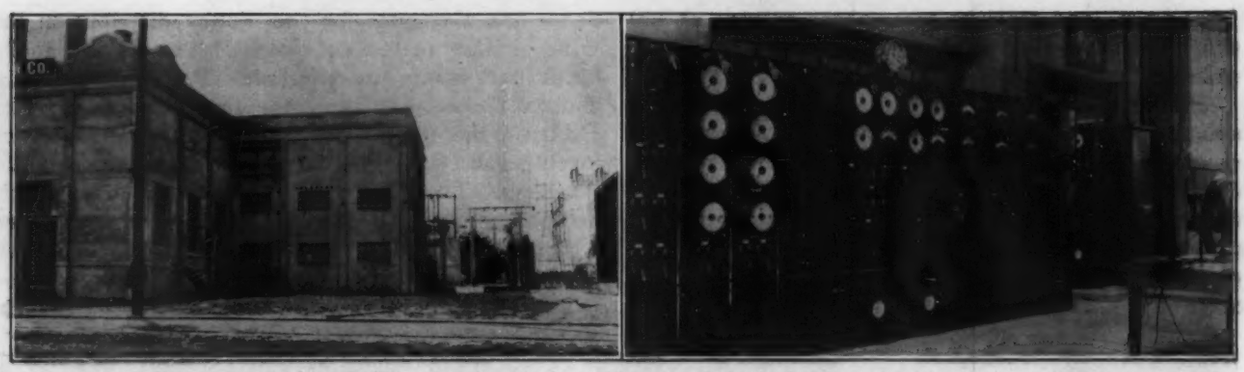


On the Right—View of Boiler Battery and One of the Main Turbines.
To the Left—Derrick for Handling Transformers,
Rear Connections of 6600-Volt Busses, Generator Rheostats, Etc.

There are two Platt Iron Works, double acting boiler pumps, cylinder 12 x 7 x 12 in. Also Stilwell No. 4 feed-water heaters. In the hotwell which is open, in the main bay, there is one General Electric 7½ h.p., 3-phase motor which drives a 4-in. centrifugal pump. Another unit consists of a similar 4-in. pump driven by a Kerr steam turbine. Water for this plant is pumped from two artesian wells having a depth of about 450 ft. North of the power house and occupying a ground space 85 x 90 ft., is a wooden cooling tower which stands 25 ft. high. Through this structure the hot circulating water from the condensers is allowed to drip, thereby giving off its heat and falling on a concrete floor from which it is drained off into the circulating system. This tower has a cooling capacity of 6 cu. ft. of water per second. The building is furnished with a Whiting Foundry Equipment Company hand-operated traveling crane, having a capacity of 20 tons.

The main switchboard is in 10 panels. It is black slate and was furnished by the Westinghouse Company. The first two panels control high tension switches through remote control connections, and also support the transmission line meters. The third panel has a control for the Valley distribution lines with similar meter equipment. The next panel is blank for future installations. Panels five and six control the output from the main turbo-generators. Each of the next three control an exciter set, and on the last panel are mounted two General Electric type T. A. potential regulators. On another switchboard of the same make there are 10 panels controlling local city circuits, on the back of these are mounted the oil circuit breakers. Also one power panel, 6600 volts and one station panel and detached are one 440 volt fuse panel and a station lighting panel. Throughout this switchboard apparatus is equipped with ammeters and voltmeters, recording and indicating wattmeters, frequency and power factor meters and synchroscope. In the rear of the main switchboard and placed in concrete cells are the 6000 volt turbo-generator switches. These are Westinghouse type E, and have solenoid control. From these the conductors are carried to the next floor where, after passing disconnectors connect to two sets of buses mounted in concrete cells.

From each end of both buses, circuits are carried to the third floor to sectionalizing disconnectors and from each set of these to an oil circuit breaker, the one connecting to the transformers of the main transmission and the other to transformers on the Valley distributing lines. The two leads are then connected through a third oil circuit breaker. In a compartment on the second floor are a Cutler-Hammer motor operated rheostat for the Allis-Chalmers main unit, and a General Electric motor operated rheostat for the other main unit. There are also two General Electric 40 k.v.a. potential regulators for the 2300 volt local city circuits. There is also on this floor a repair shop. The second and third floors are reached by a circular iron



San Bernardino Steam Generating Station, Showing Cooling Tower on Right and Transformer Station in Background. View on Right Shows the Main Switchboard.

staircase. On the main floor at one side are placed three 6600-2400 volt, 200 k.v.a. Allis-Chalmers, water and air cooled transformers to give the proper voltage reduction for the local city circuits.

One of the singular features here is a large space in the wing extending to the roof in which is placed a steel derrick of size and capacity to move and raise the large high tension transformers in case of repair. A track entering through a large door affords the means of moving the transformer under the derrick.

From this plant are controlled all of the distributing transmission lines for the territory south of the San Bernardino range. These include three 33,000 volt circuits to Rialto, West Riverside and Corona, and Riverside, Hemet, San Jacinto and Elsinore, also the local 2200 volt circuits covering the cities of San Bernardino and Colton.

A description of the transmission lines, high and medium tension substations, etc., will be continued in Part II of this article.

THE NEW STEAM PLANT OF THE SEATTLE MUNICIPAL PLANT.

BY J. D. ROSS.

The site of the new steam plant of the Seattle Municipal System, to be constructed as soon as the authorized bonds are sold, is at the foot of Nelson place between Eastlake avenue and the east shore of Lake Union, where the present Lake Union Auxiliary hydroelectric plant is located. It consists of a trapezoid 100 by 160 ft., facing Eastlake avenue on one side and Lake Union on the other. This site is almost ideal for such a plant. It will be reached by the belt line of the Northern Pacific Railroad; by the Eastlake line of the street railway system and by water from Lake Union and through the new Lake Washington Canal from Lake Washington and Puget Sound. In addition it has the advantage of being near the geographic center of the city and close to an apartment house district which will provide a good market for exhaust steam for steam heating. Eastlake avenue is 23 ft. above the lake and the site will permit of the turbines being on the level of the street with the condensers beneath and the boilers and pumps on the lower floor next the condensers.

Five thousand boiler horsepower of boilers, in six, eight or ten units, will be installed. They are to be equipped with ovens for burning mill refuse—sawdust, shavings and ground slabs—and also with burners for fuel oil. Steel stacks with induced draft are to be used. The boilers will supply steam at 200 lbs. pressure and 125 deg. superheat to three horizontal, direct-connected turbo-generator sets aggregating 10,000 kw. in capacity. The turbines are to be arranged in such a combination of high and low pressure units that low pressure steam for heating the district east of Lake Union may be secured at the best efficiency of the plant.

Duplicate boiler feed pumps of the multi-stage turbine type, driven by steam turbines, are to be used. The circulating pumps will be centrifugal type, driven by steam turbines, and the exhaust from the auxiliaries will be used to heat the feed water in open type feed water heaters. Piping throughout the plant will have cast steel fittings and welded flanges, high-pressure steam and feed-water pipe to be extra strong. A full set of meters, including recording steam-flow meters and recording steam gage and feed water meter will be installed.

The generators will be 2500 volt a.c., 60-cycle, two-phase machine, feeding directly into the city distribution system. The switchboard and wiring will be of the most modern type, remote control being used throughout in accordance with the practice in the existing plants operated by the lighting department. One exciter, driven by a steam turbine will be used, and a duplicate exciter will be driven with a two-phase motor on one end or a water impulse wheel on the other end of the shaft as desired. Each will be capable of supplying the whole plant alone. Motor and hydraulic duplicate drives will also be used on such auxiliaries as can thus be bettered in economy or in insuring continuous service.

The proposed capacity of the steam plant, with the usual liberal overload specification, will be sufficient to care for the entire load at present. Special attention will be paid to the feature of quick starting, with the idea that the steam plant may quickly take up the load in case of interruption to the hydroelectric generating system. With the completion of the new Cedar River dam, the new steam plant, and with the present Lake Union hydroelectric auxiliary station, the municipal lighting department will be in a position to give unsurpassed service.

THE FAILURE OF CONSERVATION TO CONSERVE.[1]

BY E. H. THOMAS.

Few policies designed for the public good have been abused like that of conservation of our natural resources.

Wise exponents of this policy repeat with tiresome monotony that smug definition of conservation: "the wise use without waste of our natural resources." This definition makes an appeal to the ordinary prudent, thrifty person. The ordinary person, however, has had neither the time nor the opportunity to investigate our conservation policies and to learn whether or not they are fulfilling the promises implied; whether or not as a result of conservation practices we are getting a "wise use" or any "use" of our natural resources.

A bureau in Washington, D. C., called the Bureau of Forestry of the Department of Agriculture, in so far as conservation affects us in any large or vital way, has had supervision and practical administrative charge of the forests, water power and minerals in and on the public domain. This is literally true, despite the fact that water power and public lands are under the jurisdiction of the Department of the Interior. This function of the forest service, supervision of resources on the public domain other than growing and protecting forests, has been usurped by the extension of the forests to cover these resources—water power, coal beds, etc.—regardless of forest conditions. None have disputed its rights. The Bureau of Forestry has been upheld by executive order. It was the pet branch of government under the administration of Colonel Roosevelt, and during those seven years it grew arrogant and tyrannical.

If mineral or water power rights are desired, the forest service has been the agency which obstructed the way. This bureau has always been ready to assume that no locator or claimant within the boundaries of any of the national forests, where most of our undeveloped minerals and water powers exist, came there with honest intent, and as a consequence every step of the proceedings under which water power, mineral or agricultural rights on national forests can be granted, is persistently contested by the forest service.

There could be but one result of such policies, the result that now obtains—stagnation.

The national forests of this country cover an area of more than 190,000,000 acres, an empire larger than Germany. Within these forests are millions of acres of non-forested lands, some 30,000,000 acres of this class, according to the Forest Service reports. As the service regards 4000 feet of timber per acre as timber lands, and as timber of that class in the Western forests is worthless, the actual area of non-forested lands is really about 45,000,000 acres. There should be room for some development here, but what are the conditions?

Hostility to development has marked our conservation policies. This hostility has gone so far as to denounce all who favored development as the foes of conservation. No resource can be touched without a long and expensive contest, in which the claimant or locator is either worn out or impoverished by the delays.

Development in progress within the areas of our national forests is today less than it was when the present forest service was created in 1897. Instead of progress in a part of this country greater than the empire of Germany, there has actually been retrogression.

Instead of use without waste, we have followed a policy of waste without use. Let me illustrate:

The report of Chief Forester Henry L. Graves, contained in the last annual report of the Secretary of Agriculture, estimates the new growth on the national forests at six billion board-feet per year. This is the crop, growing and decaying like wheat. To refuse to harvest it is to lose it. Yet this is just what the forest service has done. At six billion per year the crop for the seven-year period preceding 1912 was forty-two billion feet. What was the harvest? The reports show that the service in that same time, 1905 to 1912, cut 1,901,532,000, or less than 5 per cent of the crop.

Is this use without waste or is it waste without use?

Conservationists have had much to say about coal and water power, but when we invade that field and begin to investigate we find the same proportions of waste and use. The chief coal beds of the Pacific Coast are in Washington, British Columbia and Alaska. The coal of lowest quality is in the State of Washington, and of highest is in Alaska. California has been producing enormous quantities of fuel oil, which have practically displaced coal for all steaming purposes over the entire Coast country. This condition has forced up the price of domestic coal, because of the small proportion of lump and the large proportion of the fine coal heretofore marketed as steam coal, but for which little or no market exists at present.

In 1906 the existing coal land laws were suspended through the influence with the executive of the Forestry Bureau. The pretext for this act was the unfounded charge that some mythical interests were about to steal Alaska, and that abrogation of laws, which to this day have not been repealed, was the only method by which the alleged larceny could be stopped. Out of this has grown the Alaska issue with all its storm and stress, and present stringent coal conditions over the entire Coast.

Now what are the real facts and what have been the results of bureau abrogation of laws enacted by Congress?

The known area of Alaska's coal lands is 21,000,000 acres. Prospectors discovered these coal areas and gave them to the world. In all this vast empire 1100 prospectors staked and filed claims on the modest total of only 32,000 acres, for which they paid to the government $320,000. The government appreciated the work of these men and the hardships they endured so highly that it has refused them the land, kept the money they have paid in, and is now engaged

[1]Read before the National Electric Light Association at its Thirty-Sixth Convention, held at Chicago, Ill., June 2-6, 1913.

in trying to send many of the claimants to the penitentiary.

Up to 1907 Alaska was gaining population. Since that time it has been losing. The reason for this is the refusal of the Federal authorities to permit development. In 1907 the Alaska Syndicate perfected negotiations by which it could enter the coal fields and mine and market the coal. The syndicate owned some copper mines, it was building a railroad and operated a line of steamships. It has $20,000,000 invested, and would have put a total of $50,000,000 into the development of that region if it had not been for the assault made upon it.

A contract to mine coal was made directly with a group of locators who had staked 5 per cent of the Bering River field, and the basis of this agreement was a coal-selling contract by which the Alaska Syndicate was to deliver a large tonnage monthly to the Grand Trunk Pacific Railroad, a Canadian corporation.

This sales contract, the coal needed for coke with which to establish a smelting industry in Alaska, the steam coal used for its ships and local Alaska consumption, would have furnished the tonnage needed to make it possible for the syndicate to build a branch railroad into the coal fields.

All the elements of a great industrial development were at hand. The coal was the key. By refusing to grant titles under any existing laws all plans were upset, however, and Alaska today is a land of buried hopes when it could and should have been a great and prosperous community. Its coal for household fuel and for every industry is imported, and this with 21,000,000 acres of coal fields untouched and undeveloped awaiting some sort of government action, no one knows what.

Not less stupid has been the conservation of our water powers. It can also be said that nowhere in the realm of conservation could a wise use of a natural resource have been productive of so much good.

Water power can be wasted only by a failure to utilize it. Power from steam is generated at the expense of the world's fuel supply. Every pound of coal consumed is gone forever. It can never be replaced. Water power can be used over and over again, as often as the required head can be furnished along the course of a stream; and then over and over again along this entire course as long as the processes of evaporation and precipitation keep the forces moving. This means that just as long as streams flow on this globe water powers will be inexhaustible.

Water power will be here in the natural course of events long after coal beds have ceased to exist. To use this water power now is to prolong the life of our coal resources. The more water power we harness the more coal we have left in the ground for the needs of the future. To use this water power is to make use of a present wasted, although inexhaustible energy, and to use it is to save the nation's coal. This use would be conservation. Its non-use is profligacy pure and simple.

Are we conserving either coal or water power by our present national policy with respect to this use, or should I say non-use?

In an article printed in "Pearson's Magazine" last January, I touched upon the lack of development of water power on the public domain. In reply to this in the May issue of the same magazine, Mr. Gifford Pinchot denied the charge, but anaylsis of his denial shows it to be only an evasion.

Just before the Hon. Walter L. Fisher, Secretary of the Interior and a conservationist, went out of office, he said, in speaking of water power and its development on the public domain: "The regulations now demanded are so prejudicial to power investments that they (the investors) are not going on the public domain. These disadvantages are conceded, but no remedial legislation is in sight."

A short time ago Mr. Daniel W. Adams, an assistant forester, a practical lumberman and a former engineer with long years of service in railroad construction, filed charges of waste and inefficiency against the forest service. He did this only after a vain effort to secure needed reforms within the service. In his bill of particulars Mr. Adams discusses water power as follows: "The water powers of the national forests are at present the most important resource of the country, and as time goes on will, in my judgment, predominate over all others. The present development of this important resource is handicapped by regulations which by their nature forbid its utilization."

Here are two conservationists who have had occasion to study conditions and who know whereof they speak, who were in different departments of the government, and who agree perfectly on the reason for the non-utilization of this resource.

Mr. Pinchot's position is entirely different. He has found monopoly in the domain of power development, and he would rather have power waste its energy forever than that monopoly should rear its hated hydra-head anywhere. In replying to me Mr. Pinchot ignores the simple fact that I was discussing development within and on the national forests which cover more than one-fourth of the total area of the State of Washington. He charges that in this state "two corporations have already secured 70 per cent (nearly three-quarters) of all the water power yet developed." He remarks that "comment is unnecessary."

Let us see if comment is unnecessary.

It is variously estimated that the States of Washington and Oregon have a possible hydroelectrical development all the way from 8,000,000 to 25,000,000 horsepower. The amount developed thus far is about 4 per cent of the total available, using the lesser figure. If the two corporations "control" 70 per cent of 4 per cent of the total "yet developed," these concerns "control" between them 2.8 per cent out of a possible 100 per cent. Comment may be unnecessary, but my comment is that this is surely a fat "monopoly."

However, Mr. Pinchot can be mistaken in his figures as well as in his deductions. In this instance he is mistaken in both.

Mr. Pinchot says: "This same powerful group" (the General Electric Company) "controls 55 per cent of the water power in the State of Washington, in

which two corporations have secured 70 per cent of all the water power yet developed."

Let us now exaimne his figures.

All power sites held in this state by power concerns under private ownership have been developed. The total hydroelectrical energy now available in the States of Oregon and Washington is 311,000 developed horsepower. No two companies control 70 per cent of this however, but three companies, wholly unrelated and at widely separated points, the Portland, Seattle and Spokane regions, non-competitive because of their remoteness from each other, have developed less than 60 per cent of the total; to be exact, 181,173 out of 311,000 horsepower. The Seattle municipal plant has 27,000 horsepower and that of Tacoma 14,000, a total of 41,000. The Inland Empire Railroad has a developed project of 20,000, and the Pacific Power & Light Company 13,267 horsepower. Although the national forests of Washington state are rich in water power, two small projects only developing an aggregate of 12,000 horsepower are on the public domain. One of these has abandoned further development and has purchased private rights because of the opposition of the Reclamation Service to any extension of power development by the impounding of the waters of Wenatchee Lake.

If only 311,000 horsepower have been developed out of a possible 8,000,000, how does Mr. Pinchot arrive at the conclusion, which he states as a fact, that the General Electric "controls 55 per cent of the water power of Washington state?" If there are at least 8,000,000 horsepower, and only 311,000, or less than 4 per cent, are developed, how does he arrive at the conclusion that a monopoly exists?

Analyzing Mr. Pinchot's contention, we have found that the smallest estimate made of available power, developed and undeveloped, is 8,000,000 horsepower. The developed energy is 311,000 horsepower, or less than 4 per cent of the total. This is in the hands of six companies and two municipalities, a condition rather different from that pictured by Mr. Pinchot when he said "55 per cent of the water power in Washington is controlled" by the General Electric Company, and, "two corporations have succeeded in securing 70 per cent of all the water power yet developed."

If, however, some one really has a monopoly of water power on Puget Sound, how has it worked? This is the test after all.

Before any hydroelectrical project has been developed in this region, electric current sold here for as high as 20 cents a kilowatt-hour. Consumers pay a 6-cent maximum today. Seattle's local power, light and traction corporation is manufacturing more current than can be consumed under present demands. Last year this company delivered and used in Seattle alone 365,500,000 horsepower hours of electrical energy. It takes 3.64 pounds of Washington coal to generate one horsepower of energy. It is therefore evident that this company's development—none of it on the public domain—is saving 650,000 tons of coal per annum, and the total development of the two states nearly 3,000,000 tons, which, with the freight added, is worth more than $8,000,000.

There is a chance here for some conservation, but the real conservationists, after all, are the men Mr. Pinchot denounces as monopolists and power grabbers. They are saving the coal for future generations, and reducing the price of electriicty to present consumers; but these so-called monopolists have been forced to make huge investments to acquire private power sites, while those on the public domain remain unused and unoccupied.

The reason, and the only reason, for this is that stated by former Secretary Fisher in putting this situation up to Congress, that "the regulations now demanded are so prejudicial to power investors that they (the investors) are not going on the public domain."

When it is considered that the national forests are greater in aggregate area than all Germany, and that their administration has produced wasted crops, idle resources and a constantly growing deficit, which has mounted to nearly $20,000,000 since 1905, the conclusion that conservation has not conserved is inevitable.

Conservation is desirable. No one wants to see our resources wasted by profligate use; nor should we go to the other extreme, as we have done, of wasting them through non-use. One is as bad as the other. It is time for this country to place the administration of the public domain on a business basis, which can be done by employing practical business men to carry this work on instead of the theorists and politicians who have brought conservation into disrepute, and made it odious to that section of the country which suffers most from the stagnation of idle and unprofitable wildernesses.

ELECTRICAL METHODS OF COMMUNICATION.

The Panama-Pacific International Exposition at San Francisco in 1915 will display in a most comprehensive manner the achievements and activities of mankind during the last decade. Electrical methods of communication will provide many new and interesting features. Among these will be the now perfected system of wireless telegraphy and the latest developments in wireless telephony. The dictograph method, as well as the modern devices used in long established methods of communication by electricity, will also prove a source of much interest. The improvements in fire alarm and police signals will likewise command a great deal of attention by reason of the protection they afford to both life and property. These exhibits will be housed in the Palace of Liberal Arts. Application for space should be sent to Chief of Liberal Arts, P. P. I. E., San Francisco, Cal.

ELECTRIC PLANT PROFITS IN CHINA.

The boom in electric light and power affairs in Hongkong is illustrated in the fact that the Hongkong Electric Company (Ltd.) has declared a 16 per cent dividend on its capital stock of $600,000 local currency ($288,000 gold at present exchange), besides passing 5 per cent to reserve and writing off over 20 per cent of total capitalization in allowance for plant depreciation. The net profit the past year was $277,712 local currency ($133,302 gold).

THE CONSERVATION CONGRESS.

Fire waste in the cities of the United States as allied to Forest and Water Conservation will be given a prominent place in the deliberations of the Fifth National Conservation Congress to be held in Washington in November. Facts and figures emphasizing the tremendous loss caused by unnecessary fires will be laid before the congress by speakers of National note and means considered for the reduction of this annual waste.

General Manager W. E. Mallalieu of the National Board of Underwriters, is giving the matter his close personal attention. He has just returned from Washington where he appeared before the Advisory Board of the Conservation Congress in the interest of the fight against fire waste. In addressing the Advisory Board he pointed out that reduction in the number of preventable fires in the cities of America is closely allied to the general question of conservation. "Reduce the destruction of buildings," said Mr. Mallalieu, "and you are taking an important step toward conserving the natural resources of the country. This is especially true in relation to our forest resources. Every building that is destroyed unnecessarily involves a needless drain on the nation's supply of timber. In the course of twelve months this is a tremendous factor. By the same logic the fighting of needless fires compels unnecessary waste of water, and this too, involves the question of conservation. A large percentage of the fires in our cities can be prevented. This is what we want to help bring about, and the congress can be of immense assistance."

Officials of the congress believe that the Washington session will be the largest and most important in the history of conservation. The meeting this fall will be the first time the conservationists have met in Washington since the conference of governors in the White House five years ago. In the years between, they have been meeting in the West. This year, they propose to invade the national capital and take up the fight for forestry and the regulation of water power grants. These two questions promise to loom big in congress next fall, and it is understood that the conservationists will try to make a big demonstration just before the congress meets by bringing together leaders of public opinion from all parts of the country who will discuss the issue on forestry and water power.

CIVIL SERVICE EXAMINATIONS.

The United States Civil Service Commission announces an open competitive examination for senior electrical engineers, of two grades, on July 21st, 1913. Salaries of the first grade range from $3,000 to $4,800 per annum, and those of the second grade range from $1,800 to $2,700, with expenses when absent from headquarters. Another examination for electrical engineers will be held on July 23, 1913, and from the register of eligibles resulting from this examination, positions at salaries ranging from $1,080 to $1,500 per annum will be filled. These examinations are to be held for the purpose of securing men to work with the Railroad Valuation Committee of the Interstate Commerce Commission. Application blanks may be obtained at any branch office of the Civil Service Commission.

POLES PURCHASED IN 1911.

According to a recent Government publication, the total purchases of poles in the United States in 1911 amounted to 3,418,020 sticks of timber; of these, 2,402,724, or 70.3 per cent, were purchased by the telephone and telegraph companies; 787,649, or 23 per cent, by the electric railroad and electric light and power companies; and 227,647, or 6.7 per cent, by the steam railroads. The total number of poles purchased represents a decrease of 452,674 as compared with 1910, and of 320,720 as compared with 1909; but it exceeds the totals for 1908 and 1907 by 168,866 and 134,752 respectively. The decrease in the purchases of 1911 as compared with 1910 was confined to telephone and telegraph companies and steam railroads, while substantial increases in purchases were reported by the electric railroad and electric light and power companies.

Cedar, which has long been the preferred wood for pole purposes, supplied 61.4 per cent of the total number reported in 1911.

THE STEAM CONSUMPTION OF LOCOMOTIVE ENGINES FROM THE INDICATOR DIAGRAMS.

"The Steam Consumption of Locomotive Engines from the Indicator Diagrams," by J. Paul Clayton, has issued as Bulletin No. 65 of the Engineering Experiment Station of the University of Illinois. This Bulletin develops and illustrates the application of the logarithmic diagram to locomotive engines. It is shown that the steam consumption of locomotive engines can be determined from the indicator diagrams alone to within 4 per cent of the actual consumption as measured in test plants. Copies may be obtained upon application to W. F. M. Goss, Director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

LARGE RESERVOIR FOR IRRIGATION AND GENERATING ELECTRICITY IN ITALY.

A bill submitted to the Italian Parliament by the Minister of Public Works, acting in concert with the Ministries of Agriculture, Industry and Commerce, of Finances, and of the Treasury, proposes construction of a large reservoir by means of a dam to be erected on the Tirso River, in Sardinia, primarily for irrigation, but also for generating electric power. The construction contemplated involves the creation of a reservoir of about 40 miles in perimeter, capacity 430,000,000 cubic yards, and $5,000,000 expenditure; it will irrigate some 50,000 acres of arid land, and also afford means for generating about 10,000 horsepower (equivalent in electric power to 7456 kilowatts).

"THE PROPERTIES OF SATURATED AND SUPERHEATED AMMONIA VAPOR."

"The Properties of Saturated and Superheated Ammonia Vapor," by Professor G. A. Goodenough and Mr. W. E. Mosher, has been issued as Bulletin No. 66 of the engineering experiment station of the University of Illinois. This bulletin contains two tables of the properties of saturated ammonia and an extensive table

of the properties of superheated ammonia. The essential results are embodied in a convenient chart by means of which the usual practical problems of refrigeration may be solved graphically with a minimum of labor and with a satisfactory degree of accuracy. Copies of Bulletin No. 66 may be obtained upon application to W. F. M. Goss, director of the engineering experiment statiin, University of Illinois, Urbana, Ill.

THE SALESMAN'S CREED.

I believe in my job, I believe in my firm, I believe in my goods, I believe in myself.

The interests of My House are my interests—its friends are my friends.

I serve My House, but to serve it best, I must serve my customers honestly and well, for they are the friends of My House.

I honor My House for its principles—

The principle of Integrity.
The principle of Fairness.
The principle of Progress.
The principle of Strength.

I believe My House is founded upon the bedrock of Square Dealing with its customers and with its salesmen. With such principles behind me, what can stand between me and success?

I believe that the products of My House are important factors in the general prosperity and that in selling these products I am doing a useful and good work.

I believe that every sale I make benefits the buyer equally with myself.

And so I am proud of my work, of My House, of my product. I shall not allow the misrepresentation of others to abate that pride, nor a lessening of my own energy and loyalty to detract from the results, to which My House and I are entitled.

My House trusts me.

Shall I prove unworthy of that trust?

(Editor's Note:—The above is taken from a poster issued by the American Pulley Company, and is a creed to which every salesman might well subscribe.)

ELECTRICAL TRADE IN ENGLAND.

The imports of electrical goods and apparatus other than machinery and telegraph and telephone wire for 1911 and 1912 amounted to: Electrical goods and apparatus (other than machinery and telegraph and telephone wire)—1911, $6,985,821; 1912, $7,093,633; electrical machinery—1911, $5,113,839; 1912, $5,603,049. The corresponding exports were: Electrical goods and apparatus (other than machinery and telegraph and telephone wire)—1911, British, $13,720,483; foreign, $953,839; 1912, British, $21,266,066; foreign, $1,097,556; electrical machinery—1911, British $8,714,534; foreign, $293,338; 1912, British, $9,602,363; foreign, $333,448.

The position of the electrical trade in the United Kingdom in 1912 was very satisfactory, not so much, perhaps, in the actual turnover for the year as in the favorable indications for the future. In the colliery districts there was an increased use of electrical machinery; there was an extension of the electric railway systems in London and other parts of the United Kingdom; there were serious proposals to apply electricity to the propulsion of ships which, it is stated, will result "in the putting to sea of two vessels, one of 500 horsepower being built in England and one of 5000 horsepower being built in America"; there was a strong demand for electric machinery growing out of the great activity in shipbuilding; electric motor cars came into wider service; and there was an enlarged use of electricity for heating and cooking, as well as for lighting purposes. These conditions show how strong a position the electrical industry holds in the business world.

MARKET FOR ELECTRIC MOTOR CARS IN ENGLAND.

This office has had considerable correspondence with American manufacturers of electrically propelled vehicles who were considering their introduction into the United Kingdom. A number of years ago an effort was made to popularize the electric vehicle here, but troubles with batteries, difficulties of construction, and poor design prevented its sale. Since the remarkable improvements in storage batteries and design made by American manufacturers all these drawbacks have been removed. The price of electricity is sufficiently low to make the use of electric vehicles profitable for commercial purposes, but the difficulty has been and continues to be that the electric supply companies and the municipal electric supply departments have not encouraged the use of electricity as they might have done with profit.

INDIVIDUALISM.

BY JOHN R. MILLER.

(From Edison Current Topics, June, 1913.)

A condition of society that will permit the individual to acquire the full measure of reward for labor, be it done with brain or brawn;

That will restrain the strong from impinging on the weak;

That will nurture a kindly humanity for the helpless and afflicted;

That will not coddle in indolence the degenerate progeny of worthy parents;

That will assure to the thrifty the necessities and a fair share of the pleasures of life, and yet permit of an accumulation to this end—

That they may provide for themselves and for their dear ones against the time of the lengthening shadows, when the day's work shall have been done.

WIRELEESS TELEPHONY ON JAPANESE SHIPS.

The Toyo Kisen Kaisha (Oriental Steamship Company) has installed wireless telephone apparatus aboard the Shinyo Maru in addition to its wireless telegraph instruments. It is proposed to test out the wireless telephone apparatus on the Inland Sea of Japan and to continue its use if tests prove satisfactory. This wireless telephone apparatus is the invention of Japanese engineers associated with the Japanese Department of Communications at Tokyo.

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POWER AND GAS

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advrtisers should mail copy at least thirty days in advance of date of issue.

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Transforming the Desert

The barren West cries for water; without it, only a howling wilderness is possible, but with its proper application to western soils, no more productice lands throughout the world can be found. The great power companies of the Coast are not asleep in regard to the future possibilities of power consumption in the small pumping plants now being so generously installed in the great valleys of the West.

The electrically operated pump is a source of revenue to the power company and a joy forever to the farmer. In most of our productive valleys an abundance of water is found within 30 to 60 ft. below the surface of the ground, and a properly installed electrically operated pump possesses many advantages superior to any other known mechanism accomplishing the same end. The water is under the complete control of the land owner and he is not dependent in any sense upon his neighbors, for his supply stands ready to be applied at any instant, day or night. There are no boilers to explode, no gasoline tanks to catch fire, and above all, a perfect operation is possible without complicated parts to keep in constant repair. It is cheaper to install and costs less to operate, and this cost never fluctuates throughout the year. The complete equipment is easily started almost instantaneously, and, in the parlance of the up-to-date farmer, "it is on the job, day and night."

Above everything else, the electrically operated pumping plant makes the farm a more livable place. It lessens the so-called "continual round of pleasure" in performing the daily chores, for it brings power to the barn and with it the possibilities of delicate dishes for the invalid and a Sabbath day's rest for the housewife. A thousand comforts are added to the daily life on the farm. The house, the cooler, and the barns can be lighted at any moment in sudden emergencies. Lower insurance rates on the barn and house make security and economy possible to a higher degree. A cool breeze provided by an electric fan is ever ready for the hot summer day, while a gentle warmth for the chilly spring and autumn days is possible from the electric heater. The long winter evenings strengthen the family ties by making the home more enjoyable with the soft, pleasing yet clear steady light of the electric lamp.

The independence enjoyed by the farmer, when electrically operated pumps are installed can hardly be conceived, without comparing his new surroundings with the previous condition of servitude under which he labored before. An opportunity of power consumption of electrical horsepower by the millions is thus opened to the great power companies and happy homes by millions are thus made possible in every commonwealth of our western empire.

A representative western hydroelectric development described elsewhere in this issue, seems destined to transform what has been a desert into a veritable flower garden. This is only one instance of what western engineers are doing for the development of the country.

The Public and the Public Service Utility

It is a curious and yet unmistakable phase of the life of any great American city, that there is in the public mind a positive and deep-rooted aversion to the corporations which control great public utilities. This aversion is sometimes founded on good reason, but is more often due to an indefinable mistrust and to thoughtless prejudice. Poor service or excessive tariff provides fair cause for protest or complaint, but not for the popular presumption that any and every public utility corporation is a natural enemy to the community. We too often lose sight of the fact that the fundamental interests of a city and a corporation which operates a public utility in that city are necessarily identical or parallel. The prosperity of a public service corporation obviously must depend upon the prosperity of the community in which it operates.

The first principle of a public service corporation is, of course, to serve the public. Unless it succeeds in doing so by giving a fair measure of satisfaction, it cannot realize a profit on its investment. While the majority of public utilities are natural monopolies, no community will long tolerate a monopoly which provides inferior service.

The general hostility to public service corporations is encouraged by sensational newspapers, because their editors realize that savage assaults upon the managers and the methods of these corporations will strike a responsive chord in the majority of their readers' breasts. Of more serious moment are the intrigues, usually fostered by at least a portion of the press, of jealous rivals and the mischief-making of eternally reckless agitators.

Meanwhile the public service corporations go on from day to day providing us with utilities that we have come to regard not only as essential, but as our birthright. But, supposing for even twenty-four hours every public utility to which a civilized community has grown accustomed was suddenly cut off. Can we picture the chaos and paralysis of every-day life that would follow the sudden interruption of light service, the cutting off of our water supply, the complete cessation of the telephone system, and not a street car running? In some of these matters, indeed, we have suffered sufficiently to realize the intolerable inconvenience and the grievous losses that are involved as soon as one of these public utilities is even temporarily out of joint.

The growth of a corporation which tends to make it stronger within offers the most vulnerable point of attack to the agitator. As a corporation grows and its customers increase the effect of a strike is more keenly felt, and that this fact is realized by leaders and agitators is plainly shown by methods which are being pursued. Advantage of the public inconvenience of a strike against a large company is taken and when this corporation is made to bow to the laborer the increased wage is used as a club over smaller organizations. There is a certain limit of wage beyond which the corporation cannot be forced to go and until this point is reached, causing some definite action regarding regulation to be taken, there will probably be no solution of the strike elimination problem.

In the bustle of every-day existence we do not pause to consider the vital part that each great public utility plays in our lives, directly and indirectly, and if we did so our distrust and prejudice against these corporations might be tempered by a consideration of their merits. Certainly we should be less prone to regard these essential factors in modern civilization and business as natural enemies, and we should not be so ready to accept with approval the assaults of every reckless demagogue and to hurl our own brickbats of thoughtless criticism the moment we experience an unavoidable accident or temporary inconvenience.

Conservation

As a conserver the engineer has been far more effective than the legislator. The one utilizes natural resources and the other in trying to hoard them permits them to go to waste; one is a humanitarian whose efforts are compounded, the other a miser whose gold is buried and its power lost. The engineer constructs and upbuilds the dormant power of the waterfall and thereby benefits the human race, the legislator through a mistaken effort to conserve, retards development and progress. This is especially true of our unlimited water powers which are being bottled up, while other valuable products are being wastefully destroyed for purposes to which hydraulic energy is better adapted.

Even granting that several large corporate interests at present control the hydroelectric power of the United States, this is not a cause for alarm when these same corporations are controlled by commissions. A public utility properly regulated can do inestimable good to a community. Although the engineer should not attempt to mix himself to a great extent in politics he should see to it that men are elected who will, for a moment, lose sight of their political views when appointing public service commissioners. Every man, be he big or small. owes a certain allegiance to his state and to the nation. Engineers should at least interest themselves enough in their government to see that no petty political alliance is allowed to interfere with the control of the natural resources of the country.

There will be held this fall in Washington, D. C., a meeting of the Conservation Congress. For four years past these meetings have been held in the West. This year the conservationists propose to invade the national capital and take up the fight for forestry and the regulation of water power grants. Much enthusiasm is being displayed and it is hoped that a definite policy for development will be adopted.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

John Bird, manager Seattle office Westinghouse Lamp Company, spent last week in Portland.

Frederick G. Stafford of Buffalo, New York, is in Seattle and will shortly open an electric and steam specialty store.

John Ryan sales manager of the Western Electric Company's Portland branch spent two days in Seattle recently.

Frank A. Cressey Sr., head of the Modesto Gas, Light and Power Company, was a visitor in San Francisco the past week.

R. Worth, northwest manager American Ever Ready Company, Seattle, spent a week in Vancouver recently on business.

E. A. Finkenbeiner of the Platt Iron Works Company, Dayton, Ohio, is making a three months' business tour of the northwest.

Prof. L. J. Corbett of the department of electrical engineering of the University of Idaho, Moscow, Idaho, is in San Francisco.

W. W. Hanscom is busily engaged in the task of laying out the lighting system of the Civic Center Auditorium, San Francisco.

H. W. Beecher, manager of Charles C. Moore & Company's Seattle branch, has returned from an extended business trip to New York City.

D. E. Harris, salesman of Pacific States Electric Company, San Francisco, has returned from a two weeks' vacation amid the glories of Yosemite Valley.

G. A. Sneider of the Western Electric Company, San Francisco, is on an extended business trip through New York and Atlantic seaboard territory.

A. H. Halloran, vice-president and managing editor of the Journal of Electricity, has returned to San Francisco, after an extended trip throughout the East.

J. H. Buxbaum of the firm of Buxbaum & Cooley, electrical engineers and contractors, Seattle, spent a week at the saengerfest recently held at Walla Walla, Washington.

R. A. Griffin, manager of the pole department Western Electric Company, New York, arrived in San Francisco from Los Angeles where he spent the greater portion of the past week.

Thos. Collins, of the Westinghouse Electric & Manufacturing Company, has returned from an extended trip east. His homeward trip was through New Orleans and the sunny south, where he enjoyed all the sights and scenes of that quaint old land.

L. A. Sprague of the sales department Puget Sound Traction, Light & Power Company, Seattle, will leave July 10 for New London, Connecticut, where he will be connected with the New London branch of the Connecticut Valley Power Company, a Stone & Webster institution.

J. C. Kirkpatrick, president of the National Pole Company, Escantaba, Mich., and **W. M. Carpenter,** vice-president of the American Cross Arm Company, Chicago, who have been in Los Angeles during the past week, were in San Francisco the latter part of the week enroute to Seattle on their homeward trip.

R. G. Littler of the West Coast Engineering Company of Portland will leave on July 7th for Chattanooga, Tennesse, as the delegate of the Oregon Elecerical Contractors Association to the convention of the National Electrical Contractors' Association which meets at Chattanooga on July 15th for four days. Mr. Littler is president of the Oregon association and is also one of the directors of the National body. He will be accompanied by Mrs. Littler and they will visit Washington, D. C.; New York and other points before returning to Portland.

FOURTH ANNUAL CONVENTON OF THE CALIFORNIA STATE ASSOCIATION OF ELECTRICAL CONTRACTORS.

Following is the tentative program of the convention to be held at Santa Barbara, Cal., on Aug. 13-16, 1913:

Wednesday, August 13th.

10:00 A. M.—Business meeting, members only.
2:00 P. M.—Business meeting, members only.
2:00 P. M.—Ladies and visitors sight-seeing trip to Mission Santa Barbara.
8:00 P. M.—Reception and dance.

Thursday, August 14th.

10:00 A. M.—Business meeting, members only.
2:00 P. M.—Business meeting, members only.
2:00 P. M.—Ladies' and visitors' motor trip through the famous Hope ranch.
4:00 P. M.—Ball game in Santa Barbara Ball Park, between the Supply men and the Contractors, for the cup won by the Supply men at the last convention.
8:00 P. M.—Moonlight boat ride.

Friday, August 15th

10:00 A. M.—Open meeting.
2:00 P. M.—Open meeting.
2:00 P. M.—Ladies' motor ride to Montecito and Miramar.
7:00 P. M.—Annual dinner in the Moorish room, after which guests will adjourn to the ball room.

Saturday, August 16th.

9:30 A. M.—Baseball game between the Northern and Southern Contractors for the cup won by the Northern Contractors at the last convention, at the conclusion of the ball game the entire party will be taken to Oak Park where a barbecue will be served. All kinds of games for prizes and dancing for those who wish.

7:30 P. M.—The Statesmen of California will hold a Rejuvention of the Sons of Jove. For the ladies the management of the hotel will give a concert in the lobby by the famous La Monica Band. After the concert and rejuvenation a "Dutch Lunch" will be served in the ball room.

For those who wish to stay over Sunday, arrangements are being made to take a fishing party to Santa Cruz Island, where lunch will be served, returning to the Potter Hotel in time to catch trains returning Monday morning.

MEETING NOTICES.

Oregon Society of Engineers.

The Oregon Society of Engineers held their regular monthly meeting Thursday, 26th of June, at the Commercial Club. Dinner was provided for eighty. Papers and discussions were dispensed with at this meeting and the members took to planning big new activities for the society. That the society has broken into public notice and has become a force to be reckoned with is acknowledged on all sides. The two big accomplishments of the society for the year were the organization of a successful excursion in the interest of the University of Oregon and the putting forward of a successful candidate for commissioner under Portland's new form of government. No further meetings of the society will be held until Thursday, September 11.

Oregon Technical Club.

Mr. Melvin W. Boyle, of the Trussed Concrete Steel Company, presided at the regular Monday luncheon of the Oregon Technical Club. Mr. Marshall N. Dana, of the Oregon Journal, spoke on the "News Getting Organization of a Large Daily Newspaper." Mr. Roscoe Fawcett, sporting editor of "The Oregonian," gave an exceedingly interesting exhibition of many "sleight of hand" tricks. Mr. Dana digressed from his subject and gave the Technical Club some wholesome advice. He said in part: "Technical men as a class do not make their presence felt in the community nearly as much as they should, being trained as they are, because they do not make

enough effort to reach the public in the every day language of the layman. The layman can not understand their language if he wanted to, and the only remedy is for the engineer to adopt the layman's methods of expression, and thereby get the public ear."

NEWS OF CALIFORNIA RAILROAD COMMISSION.

An order has been issued granting authority to the Lassen Electric Company to purchase the Branham plant, at Susanville, for $4500.

The San Diego & Southeastern Railway Company has applied for authority to issue $600,000 of bonds.

The Western States Gas & Electric Company has applied for authority to issue $354,000 of bonds for the purpose of making additions and betterments to its system.

A decision has been rendered granting authority to D. C. Gillen to sell his electrical distribution system in Colfax to the Pacific Gas & Electric Company for $12,000.

The Pacific Gas & Electric Company has applied for authority to extend six promissory notes in the total sum of $150,000.

The Pacific Light & Power Corporation has applied for authority to issue $2,500,000 of stock for financing work upon the Big Creek hydroelectric project.

NEWS OF WASHINGTON PUBLIC SERVICE COMMISSION.

The Washington public service commission will hold a session the latter part of July or early in August to determine the rates which North Yakima, Walla Walla and some 25 other towns in the Yakima, Columbia and Touchet valleys shall pay for electricity. The general hearing will be held in North Yakima. The Pacific Power & Light Company with headquarters at Portland, is the concern involved. On account of numerous complaints the commission some time ago ordered its engineers to go over the entire plant. After the general hearing a special session for each community will be held to determine how much of the total valuation can be charged against that city and what shall constitute an equitable rate in that community.

NEWS OF ELECTRICAL CONTRACTORS.

The Gamewell Fire Alarm Police Telegraph Company, Cantral building, Seattle, has the contract for putting in a 25-box fire alarm system for Pendleton, Oregon, a similar system for Wenatchee, Washington and small systems for Pasco, Washington, and Hood River, Oregon.

W. R. Hendry & Company, Seattle, have been awarded the contract for installing the electrical equipment, with automatic control system, for the pumping plant to be used in connection with the siphon tunnel constructed by the city of Seattle under the Lake Washington canal.

The contract for the complete wiring in the William A. Rhodes building, at Ninth and St. Helens streets, Tacoma, has been let to George H. Keep & Co., local contractors. The building is to be electrically equipped throughout. Heating will be by means of electric radiators. The apartments will have electric water heaters and stoves.

CHANGE OF ADDRESS.

The American Electric Company, Seattle, electrical contractors and supply dealers, has moved from 118 Third avenue to 714 Third avenue.

On and after July 1st, 1913, the address of the Blake Signal and Manufacturing Company will be 251 Causeway St., Boston, instead of 246 Summer street as heretofore.

The Caldwell Machinery Company, formerly at 524 First avenue South, Seattle, has moved its offices to 512 Colman building. The warehouse and show rooms of the company will be at 804 Post street, same building.

TRADE NOTES.

The City of Port Angeles, Wash., has purchased from the Seattle office of the Fort Wayne Electric Works a 100 kw. alternator for its municipal lighting plant.

George B. Adair & Son Co., Seattle, has been awarded the contract for installing a 50 h.p. Class C DeLaval turbine for the Silloam Sanitarium at Soap Lake, Wash.

The Erie Mill Company, Blaine, Wash., is preparing to install electric motors in its new planing mill. These motors will be furnished by the Allis-Chalmers Company.

The Fobes Supply Company of Seattle has received a contract from the University of Washington for 10,000 ft. of lead-covered cable and 60 pole base transformers.

Birks & Sons, jewelers, Vancouver, B. C., have just placed an order with the Canadian Johns-Manville Company for about 500 ft. of Frink reflector for cases and show windows.

Evans-Dickson Company, Tacoma, have the contract for installing machinery in the substation at Fort Flagler; also contract for additional wiring in the capitol building at Olympia.

The Union Electric Company, Seattle, has installed a 20 kw. type k. s. generator and 3 h.p. slow speed motor at the Troy Laundry. The laundry is electrically operated with individual drive.

The pole depot of the Western Electric Company at Weco, Cal., was destroyed by fire during the past week. It is estimated the loss is between five and six thousand poles. The origin is supposed to be grass fire.

The Tacoma Electrical Machinery Company, 759 South D street, Tacoma, recently installed a 50 h.p variable speed 3-phase motor in the Tribune building. This company has also installed an automatic electric dumb waiter in the Lotus bar grill room.

Kilbourne & Clark Manufacturing Company, Seattle, has obtained some very satisfactory tests on its micromagnetic detector, an instrument for receiving wireless messages invented by Frederick G. Simpson, chief engineer and general manager of the company.

The Arrow Electric Company, Seattle, is building an electrical float to represent the Rainier Valley district at the Potlatch festivities. The float is being made to represent Mount Rainier in eruption, with electrical decorations around the base advertising the district.

E. A. Finkenheimer of the Platt Iron Works, Dayton, Ohio, recently closed a contract with Oregon City, Ore., in behalf of his company to install an 1800 h.p. water wheel unit to operate under a 40 ft. head at a speed of 240 r.p.m., to be direct connected to a 1200 k.v.a. generator. Charles C. Moore & Co. are the local representatives of the Platt Iron Works,, and the contract was secured through their co-operation.

Bates & Clark, electrical engineers, Seattle, are preparing the plans, furnishing the apparatus, and will supervise the installation of 4-stage 16-inch turbine pump, weighing 50,000 lbs., direct connected to a 1500 h.p. 3-phase synchronous Allis-Chalmers motor, to operate two 5-in. hydraulic giants on a placer mining property near Gold Hill, Ore. This will be one of the largest high-pressure pumps ever operated on the Pacific Coast.

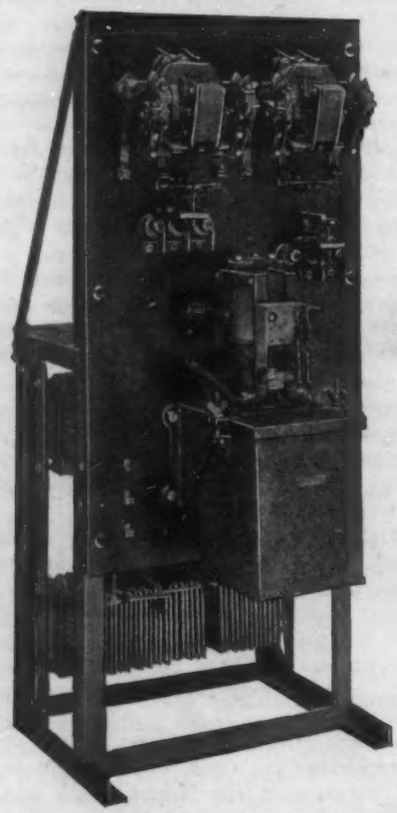
ELECTRICAL CONTRACTORS' LICENSE FIXED AT $20.

The recently enacted San Francisco ordinance requiring electrical contractors to pay a license of $50 a year was amended at a meeting of the Building Committee of the Supervisors this week. The fee was fixed at $20 a year instead of $50, so as to give an equal chance to both small and large contractors. The provision requiring the contractors to file a $100 bond in order to get a permit was declared invalid and hereafter the contractors will save this expense.

INDUSTRIAL

AUTOMATIC CONTROLLERS FOR HIGH VOLTAGE MOTORS.

The Cutler-Hammer Manufacturing Company of Milwaukee has designed a new line of high tension automatic control panels. One type is designed for use with motors driving reciprocating pumps, air compressors or other machines which must be started under full load conditions, and which require a starting torque equal or in excess of the normal full load torque of the motor. The other line, having the same appearance as that shown in the accompanying illustration, is designed for use with motors driving centrifugal pumps, or machines of similar load characteristics, starting under light load conditions. The acceleration is controlled by resistance in each of the three phases of the rotor which is cut out, step by step, by double pole magnetic switches under the control of current relays. By adjustment of the relays the starting current can be set at a predetermined value and the motor accelerated in the shortest time consistent with this current. An oil-immersed solenoid-operated three-pole switch is also

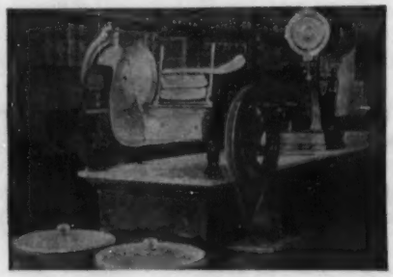


Cutler-Hammer Automatic Controller.

mounted on the panel which controls the high tension motor primary circuit. Where used on water systems, air or vacuum systems, suitable accessories such as float switch, gauge and diaphragm type pressure regulators and vacuum regulators are available.

MOTOR DRIVEN MEAT SLICER.

Motor-driven meat slicers are rapidly taking the place of the butcher's knife and hand-operated machines. In rapidity, cleanliness, convenience and economy, the motor-driven machine has no rival. The work of installation is very simple, and the cost of operation is only about one-half cent an hour for continuous operation. With a hand-operated slicer, a great deal of the clerk's time is taken from his most important duty, that of waiting on the trade, whereas, by the use of motor drive, the work is done much quicker and the customers given better service. A small electric motor can very



Motor-Driven Meat Slicer.

easily be belted to any rotary type of slicer, as shown in the accompanying illustration. The motor, if desired, may be mounted on the floor, wall, or ceiling, or on a bracket as here shown. Motors adapted to this class of service are manufactured by the Westinghouse Electric & Manufacturing Company.

MOTOR DRIVEN COFFEE MILL.

An ordinary double-flywheel type of coffee mill operated by hand can very readily be changed to motor drive. The work of installation is simple and inexpensive. The cost of operation is almost negligible since more than 25 lbs. of coffee can be ground for one cent. With an electrically driven mill,

Motor-Driven Coffee Mill.

the clerk fills the receptacle, turns the starting switch, and, while the coffee is being ground, continues waiting on the customers. When grinding a large quantity of coffee at one time, a motor-driven mill not only saves time but also a great deal of hard work, as hand grinding is especially irksome if prolonged. The motor can be mounted on the floor or wall close to the mill, or, as illustrated herewith, on the frame. Motors especially adapted to such service are manufactured by the Westinghouse Electric and Manufacturing Company.

NEWS NOTES

ILLUMINATION.

BAKER CITY, ORE.—The city is considering the installation of a small hydroelectric plant to cost about $25,000.

SUTTER CREEK, CAL.—Sealed bids will be received up to July 21 for an electric lighting system for the city of Sutter Creek.

SAN FRANCISCO, CAL.—The supervisors have passed a resolution setting aside $5000 for illumination purposes during Portola celebration next October.

OAKDALE, CAL.—J. R. Anderson has been granted a franchise for a period of 50 years to lay gas pipes in the streets and thoroughfares of the city of Oakdale, for heat, power and light.

LOVELOCK, NEV.—Steven R. Young of this city, practically sole owner of the Woolsey Light & Power Company, has acquired by purchase the plant and franchise of the Lovelock Light & Power Company.

BELLINGHAM, WASH.—The council has gone on record as being in favor of municipal ownership of a projected light and power plant on the Nooksack River. A committee has been appointed to investigate the project.

OXNARD, CAL.—An election will be held on July 24th for the purpose of submitting to qualified voters the question of whether $30,000 bonds issued for a municipal street lighting system shall be used to purchase and acquire the system of the Ventura County Power Company.

COUER D'ALENE, IDAHO.—The question of installing a municipally owned light plant has been taken up by the councilmen and it has been generally favored. It is proposed either to buy the existing plant or to build a new one. This question will be put to the people later in the year.

VANCOUVER, B. C.—Plans for a gas generating plant in Hastings townsite for the Vancouver Gas Company, to supersede one on False Creek, have been definitely placed before the Civic Board of Works by F. R. Glover, general executive assistant to the British Columbia Electric Railway Company. The first unit is to cost $750,000.

TRANSMISSION.

SPRINGVILLE, CAL.—All rights of way for a new power line which is to be built by the Mt. Whitney Company from the Frazier Valley substation to this city, have been secured and work on the line started with a large force of men this week.

CENTRALIA, WASH.—A crew of men is now at work between Castle Rock and Lexington on the last link of a power line which will connect all of the towns served by the Washington-Oregon Corporation as well as all of the power plants of that concern.

SEATTLE, WASH.—The Olympia Power Company, Port Angeles, Wash., has awarded the contract for the reconstruction of its power dam on the Elwha River to James E. Heyworth of Chicago for $500,000. The dam will be 200 feet high, 600 feet long, and will have solid concrete foundation.

WASHINGTON, D. C.—Secretary of the Interior Lane has recommended and the President has ordered the restoration to entry of 2500 acres on the Owyhee River held unsuited for the conservation of water power, also modification of an order withdrawing 1291 acres known as power site No. 77 on the Snake River in Oregon and Idaho.

SEATTLE, WASH.—The Puget Sound Traction, Light & Power Company has made application for a franchise to construct a single line of poles, with all necessary appurtenances for telegraph and telephone purposes, and to convey electric energy for lighting, power and heating purposes along specified roads, and other public places in King county.

BREMERTON, WASH.—The city of Bremerton is to have a municipally owned electric light plant. It has accepted the proposal of the Bremerton-Charlston Light & Fuel Company to sell for $90,000. The purchase calls for $25,000 cash for which bonds have already been sold to John E. Price & Company and the acceptance of the remainder of the purchase price in utility bonds.

LOS ANGELES, CAL.—The Pacific Light & Power Company has begun construction of its transmission line from the Big Creek hydroelectric development to Los Angeles. The Big Creek development will be of 150,000 h.p. and the transmission line will be 248 miles long, said to be the longest high tension transmission line yet constructed. The line will carry current at 120,000 volts. At Los Angeles the current will be distributed to the city systems and also to the Pacific Electric Railway Company and other utility corporations.

SAN FRANCISCO, CAL.—The State Conservation Commission has begun the hearing of a controversy involving two power and irrigaton projects in Lake and Yolo counties, the conversion of Clear Lake into a storage reservoir, and the carrying of water to more than 100,000 acres of land. The Yolo Water & Power Company is contesting before the commission the right of the Power & Irrigation Company of Clear Lake to carry out certain power and irrigation projects, as defined in the latter company's application to the commission.

SAN FRANCISCO, CAL.—The Sierra & San Francisco Power Company has filed a petition in intervention with the commisson in the Oro Electric Corporation's application to enter Stockton and other portions of San Joaquin county. The Sierra & San Francisco Power Company contends that in the recent order authorizing the Oro Electric Corporation to enter certain portions of San Joaquin county it was allowed to encroach upon the section in which the Sierra & San Francisco Power Company is operating. The Sierra & San Francisco Power Company now asks that this feature of the case be re-opened.

TRANSPORTATION.

SALT LAKE, UTAH.—The interurban electric roads, which include the Orem and Bamberger lines, have determined upon erecting a union station on West Second South street, to cost $40,000.

SACRAMENTO, CAL.—The first electric train between Sacramento and Oakland on the Oakland, Antioch and Eastern, left Sacramento Wednesday morning. This marks an important epoch in local transportation circles.

OAKLAND, CAL.—Walter Arnstein of the Oakland, Antioch & Eastern Railway, has announced that work on the company's new ferry steamer is practically finished and that the boat, which will accommodate eight cars, will leave the yards of the Union Gas Engine Works shortly for a trial trip. A regular schedule between the Key Route pier and the Solano region will be established about July 6, and trains will be running through to Sacramento by August 15. The suburban line is operating over the Key tracks and

mole under arrangement by which a minimum of 50c per car is guaranteed on a basis of full fare for each passenger carried from the junction of the two roads to the Key system ferry slip. The minimum, according to testimony given before the railroad commission, has been $3 per car since the cars began to operate in April last.

SAN FRANCISCO, CAL.—All electric railway lines in the State and the smaller steam roads will be required to file the names of their stockholders in connection with their annual receipts for the fiscal year, which are due to the railroad commissioners after July 1. Electric and power and water companies hertofore have been asked for this information, but transportation companies have been exempt.

FRESNO, CAL.—Construction of the railroad from Muscatel to the townsite of Biola will start about July 15, according to an announcement made from the offices of the Fresno Traction Company. Right of way matters are in such shape now that everything can be turned over to the Fresno Traction Company upon the return of F. W. Webster, general manager. The road was originally promoted by J. B. Rogers and associates.

OAKLAND, CAL.—The Oakland, Antioch & Eastern Railway Company, through Jesse H. Steinhart as counsel, argued before Commissioner Loveland for permission to issue $4,000,000 of its bonds, $1,000,000 of which amount it desires to issue immediately, for construction and other purposes. The total authorized bond issue of the road is $5,000,000, and its capital stock amounts to $10,000,000. Vice-President Samuel L. Naphthaly testified that the road is now operating successfully from Oakland to Bay Point, and that the remainder of the line through to Sacramento is practically completed. The approximate total mileage is 99 miles of main track. The receipts from the sale of bonds to date amount to $2,117,362, of which $500,000 of the bonds have been sold under a contract containing an option clause. The original cost of the road is placed at $3,707,530, which comprises the amount actually expended in constructing it and an estimate, based on such actual expenditure, of the cost of its completion. In arriving at the reproduction value of the road no allowance was made for the extra expense entailed in securing rights of way. The reproduction value is placed at $4,390,523, or $70,170 per mile, as against $59,250 per mile, actual original cost. The commission raised objections to the proposed sinking fund of the company. Commissioner Gordon stated that it was possible changes might be advised before the bond issue was authorized.

TELEPHONE AND TELEGRAPH.

PETALUMA, CAL.—At the annual meeting of the Petaluma Rural Telephone Company the company announced plans to build new lines in various districts.

IMPERIAL, CAL.—Work has been commenced on a toll line between Imperial and Brawley and Imperial and El Centro for the Imperial Valley Telephone Company. Long distance lines will receive first attention.

EL PASO, TEXAS.—Wireless stations will be established immediately by the United States army along the Arizona-Sonora border in order to have direct communication with out of the way places. The wireless stations will be in communication with headquarters at Fort Bliss. The main station will be placed at Sasabs, Arizona.

SAN FRANCISCO, CAL.—At the hearing before the railroad commission in the matter of a readjustment of long distance telephone rates J. P. Shaw, the commission's rate expert, recommended the adoption of a two-minute initial period and the elimination of the 5-cent "terminal" charge. The plan proposed by the Pacific Telephone & Telegraph Company involves the reduction of the present three-minute initial period to one minute with a charge of 50 per cent of the first-period rate for each minute of conversation over the minimum. It also proposed to retain the present 5 cent terminal charge. Shaw declared that his investigations show that the present average duration of long distance conversations is 1.65 minutes and that, under the schedule of rates proposed by the company, $200,000 per annum would be added to the company's net revenues, while his plan would mean a reduction of $400,000 per annum in the tolls paid by long distance telephone users. The company has until July 29 to study and reply to the commission's plan.

WATERWORKS.

TACOMA, WASH.—The Fern Hill residents have petitioned for water service from Green River.

PORTLAND, ORE.—Stoddard & Richardson of Portland are completing plans for the municipal light and water plant to be built at Baker, Ore.

SANTA CRUZ, CAL.—The proposition to bond the city for $220,000 to redeem the water plant, met with almost unanimous approval at a recent election.

LIVINGSTON, ORE.—The city will shortly add two pumps to its water system. The pumps will deliver 75 gallons per minute each, against a head of 550 ft., and will cost $25,000. Since the city has reached the bond limit this improvement will be paid for by the property owners benefiting thereby.

PHOENIX, ARIZ.—The Williams Water & Electric Company without further delay will issue and sell bonds in the sum of $150,000 for the improvement and extension of its system. The bonds will be of $1000 denomination each. This company furnishes water and power to the town of Williams.

OROVILLE, CAL.—An appropriation of 50,000 inches upon the waters of the Middle Fork of the Feather River has been filed by J. H. McKibben, a real estate dealer of San Francisco. The water is to be brought to Oroville by flumes and ditches to a point south of the city.

SAN FRANCISCO, CAL.—The supervisors have passed the ordinance fixing water rates for the coming fiscal year, the charges being the same as those of the present ordinance except that a reduction of 25 per cent in the present charges for water furnished shipping is provided.

DALY CITY, CAL.—Following the success of the Daly City water bonds at the recent election, work will be started immediately. Roberts & Denicke have been appointed engineers of the work. It is proposed to sink five wells about a mile from Lake Merced, where after investigation it was found that there was an abundance of water to furnish a supply for many years and carry the water by pipes to Daly City.

GLENDALE, ARIZ.—An election will be held on July 5th for the purpose of submitting the question of insuring a bonded indebtedness in the sum of $35,000, the proceeds to be used for enlarging and improving the waterworks to be owned and controlled under the jurisdiction of the town. Said bonds are to be of the denomination of $500 each, bearing interest of 6 per cent per annum, payable semi-annually.

WOODLAND, CAL.—R. H. Beamer, manager of the Yolo Water & Power Company has taken a crew of engineers to Davis to make preliminary surveys for an extension of canals. Farmers east of Davis have asked that the Winters-Davis canal be extended east from the State farm. This may be done as soon as the rim around Clear Lake has been acquired, so that the water level can be raised and an ample supply of water insured.